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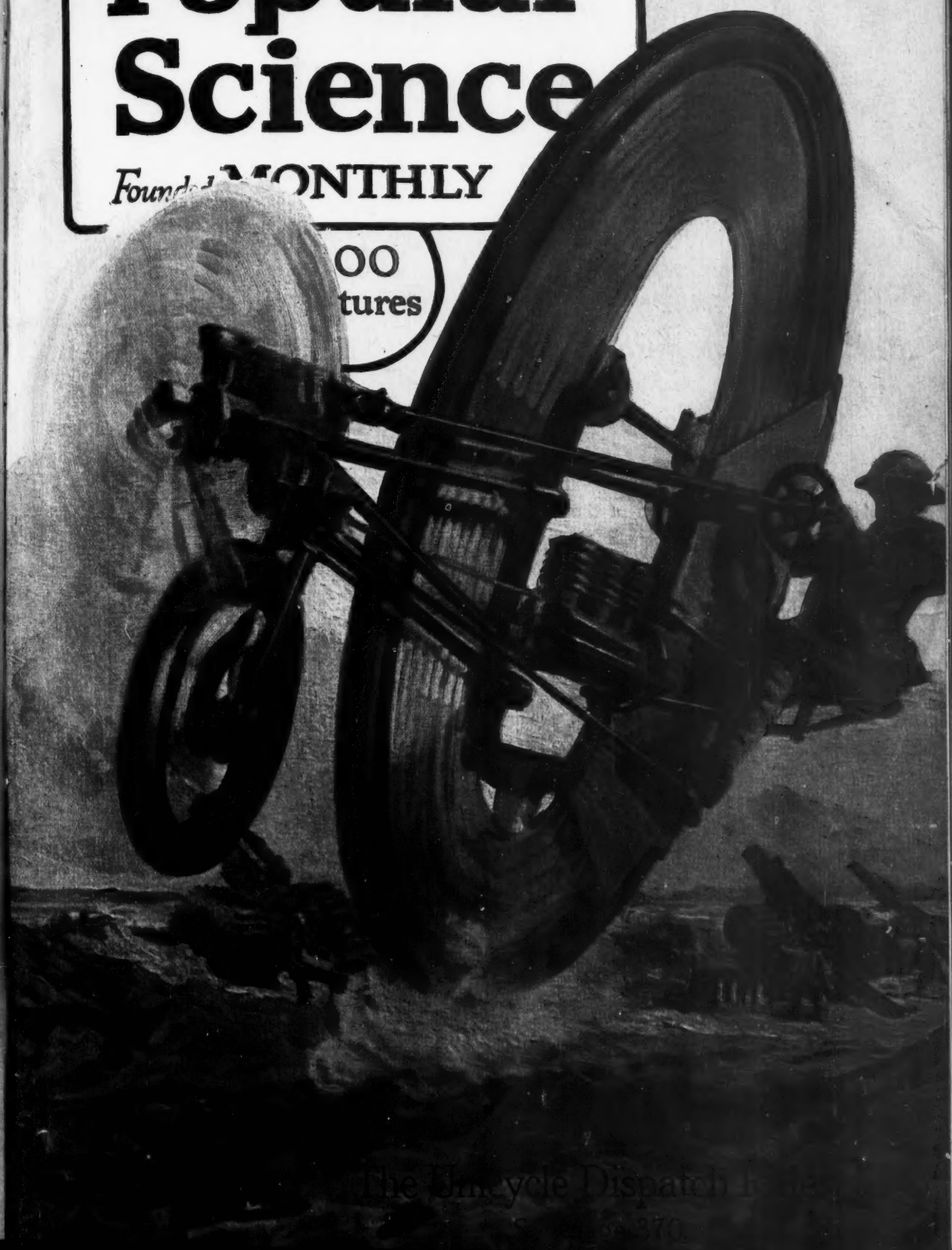

The Unicycle Dispatch

Victrola XVII, $250
Victrola XVII, electric, $300
Mahogany or oak

Victrola-the highest attainment in the arts of sound

The mission of the Victrola is purely one of transmission. The recorder and reproducer should tell the simple truth, no more, no less.

The Victrola is not an instrument in which the interpretation and expression depend on the player like the organ, piano, etc. No instrument can be made to *improve* on Melba, Caruso and the other great artists. The true function of the Victrola is to reproduce faithfully the work of these artists.

The only modifications permissible are those obtained by *changing the needles* from *loud tone* to *soft tone* and by adjusting the *sound doors* to suit the size of the room or the mood of the listener.

There are Victor dealers everywhere, and they will gladly play your favorite music for you and demonstrate the various styles of the Victor and Victrola—$10 to $400.

Victor Talking Machine Co., Camden, N. J., U. S. A.

Berliner Gramophone Co., Montreal, Canadian Distributors

Victor Supremacy

"Victrola" is the Registered Trade-mark of the Victor Talking Machine Company designating the products of this Company only. **Warning:** The use of the word **Victrola** upon or in the promotion or sale of any other Talking Machine or Phonograph products is misleading and illegal.

To insure Victor quality, always look for the famous trademark, "His Master's Voice." It is on all genuine products of the Victor Talking Machine Company.

New Victor Records demonstrated at all dealers on the 1st of each month

Important Notice. Victor Records and Victor Machines are scientifically coordinated and synchronized by our special processes of manufacture, and their use, one with the other, is absolutely essential to a perfect Victor reproduction.

Let the Popular Science Monthly Send You a Check

Do you know an interesting photograph when you see one?

Then you should be receiving checks regularly from Popular Science Monthly.

Go to the nearest newspaper office and ask the editor for the names of inventors in your town. Find out what each is doing. If one has invented a device to catch chicken-hawks with kites, another an apparatus to kill flies by electrocuting them, and a third a treadmill for his dog, and so on, let us have articles, with photographs or drawings—quick!

Do you know that photographers' studios are mines for some authors? Go to the nearest studio. Ask the photographer to let you look through his plates and prints. Pick out the novel, the curious pictures, and mail them to us.

Is there a big manufacturing plant in your town? Did you ever go through it with your eyes open? How do you know but some mechanic in that very plant has invented a machine which is saving his boss a thousand dollars a week? Shouldn't the whole manufacturing world hear of that man?

How about the big engineering jobs in your neighborhood? Do you know that contractors never dig two cellars alike? Keep an eye on them. Look out for new labor and time-saving machines.

Now get busy and receive some checks.

News to you is something which is new to you.

Is the picture of Italian soldiers with blackened faces on Page 382 of this issue news to you? We put it there believing that it would be.

On Page 333 is shown a roof bungalow. One of our readers happened to discover this unique mode of living, and recognizing something new, he immediately obtained photographs, and sent them to us. They were news to us and we paid him for them.

The Land Torpedo in Action

A small, but high-speed automobile is sent straight for the enemy. Caterpillar wheels and wire cutters can be provided when necessary. On reaching the trenches, the half ton of explosive and shrapnel is ignited electrically, blowing the barbed-wire entanglements to pieces

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Why Not the Land Torpedo?

Mount it on an automobile; open the throttle wide; and let the machine rush to the enemy's trenches

THE submarine torpedo is the most destructive weapon of the sea. Then why not a land torpedo? A cheap vehicle could be made to carry a high-explosive mine, a huge shrapnel, or a missile which would be a combination of both. Where necessary, provide the vehicle with caterpillar wheels and with a wire-cutter, and dispatch it toward the enemy, over shell craters and through entanglements into the opposing trenches. There the charge could be exploded, and the men and property within blasted into oblivion.

The originator of this plan is Felix Sabah, of Philadelphia, whose idea as he has conceived it is illustrated in action. The ground of "No-Man's Land" being flat, ordinary gasoline automobiles of small size are used. In them the charge is carried, consisting of about a thousand pounds of explosive, mounted on the crutch-like frames. The firing wires which lead back to the electric igniting coils are seen in our picture projecting from the rear. The outposts are telephoning the order to fire. The fatal button is pressed—then ghastly destruction.

And the enemy? Has he no defense? No doubt he will erect concrete barriers, and blast huge craters. Caterpillar wheels, however, would be a single means of overcoming the craters. The use of percussion caps, which would ignite the torpedo charge on striking the walls, would be one way of smashing through them.

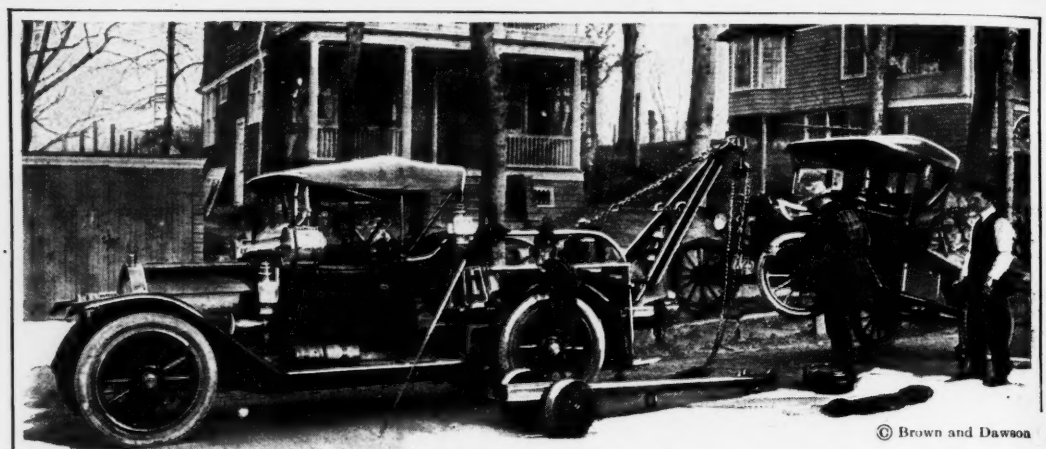
Let us not forget that once we can get the torpedoes there, the rest will be easy. If nothing else can be used, time-fuses will set off the charge at the proper instant.

The other military considerations involved in the practical application of the project are much more simple. There will be no difficulty in constructing the light type of automobile that would be required. In fact, the plan would provide the means of giving many an antiquated automobile which is about ready for the junk heap, its opportunity for making its last sacrifice.

From the shipping point in Europe, the men of the "Land Torpedo Corps" could each ride an automobile directly up to the front, thus relieving the railroads of the burden. Here the torpedo charges could be mounted, tests could be made, and everything could be planned for a concerted assault.

To launch the torpedoes on this drive, competent officers would have to set and lock the steering gears. Throwing open a clutch from the rear of the machine, the automobile leaps ahead audaciously. The vital parts being armored, the enemy will be unable to damage it severely when the machine is seen to be rushing towards them at some sixty miles an hour.

Closely resembling this land torpedo is the torpedo car described on page 526 of the April issue of the Popular Science Monthly. It too is designed to take the place of artillery in preparing the way for infantry attack. A torpedo carrying several hundred pounds of high explosive is mounted on a chassis. The propelling power may be either gas, steam, compressed air or a storage battery or electric motor. Its most important feature concerns the method by which it is guided and fired. This is done by means of cables and wires in the hands of the attacking party, which is a noteworthy advantage over the land torpedo described in this article. Furthermore, the torpedo car, should it not reach the enemy because of rough ground, can be drawn back to the trench from which it was started by a simple pull on the control cable. The torpedo car would cost about one thousand dollars, whereas the modern naval torpedo costs seven thousand dollars.



© Brown and Dawson

The wrecking car answers calls within a radius of one hundred miles, night or day

Salvaging Motor Wrecks with a Special Equipment Car

WE have long been familiar with the wrecking train of the railroad with its special crew of trained mechanics and its hoists and derricks for clearing away debris or setting cars back on the track again in case of wreck or collision. But it is only recently that the wreckers for the motor world have come into view. One of the best equipped cars of this kind is operated by Mr. Meehl in Portchester, N. Y.

The wrecking car with its crew is ready for instant service and answers calls within a radius of one hundred miles at any hour of the day or night. The car itself is a simple chassis. On the rear end is a two-ton hoist and all sorts of rope pulleys and tackle, besides jacks and tools for emergency repairs. A two-wheeled truck is part of the equipment and is used when towing cars whose wheels are out of commission. Two powerful acetylene searchlights are used to light up any night work and two heavy jacks are carried on the running board which are used to jack up the rear wheel when there is any hoisting to do and take the strain off the tires. With this car it is possible to tow in a wrecked car, no matter how badly it may be broken up and it is possible to pull the car out of any kind of a hole. It has frequently had occasion to hoist cars out of streams or up an embankment twenty-five or thirty feet high.

How the Eskimos Taught Us to Take the Glare Out of Motion Pictures

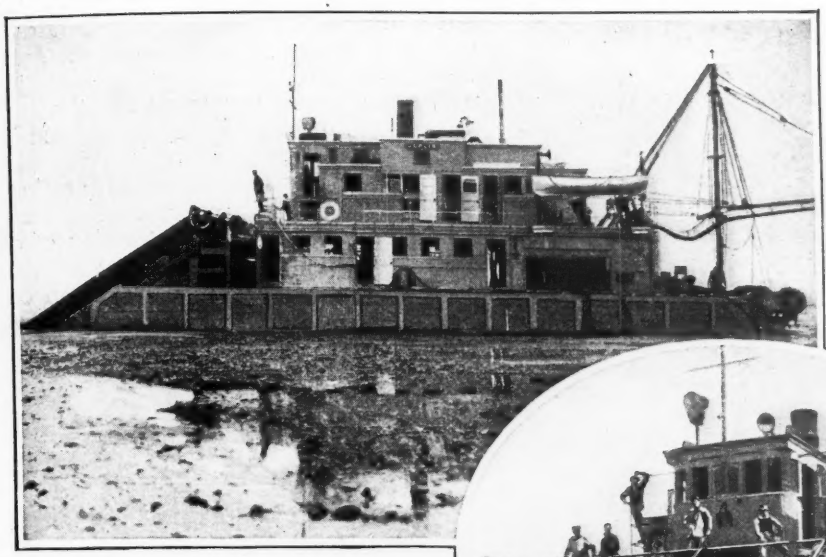
HAVING suffered from the flickering and glare of motion pictures, Dr. F. C. A. Richardson, of New York City, developed a pair of opaque eye-glasses with narrow slits in them, through which he views the pictures without the slightest discomfort. The Eskimos have used similar glasses for years in preventing snow blindness.

When a person looks at a motion picture with the naked eye, he receives the intense rays through a comparatively large area of the eye. Less than one-half of these rays are necessary. The other half simply tax the eye. They add nothing to the clearness of the picture and produce the intense glare.

The slits in these opaque glasses admit only a small percentage of direct light rays to the eye

Potash from California Sea Kelp

Subterranean reapers harvest the product

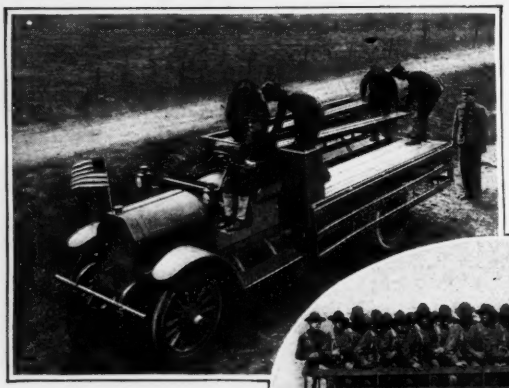


The harvester waiting for the tide to come in before it continues its undersea kelp-cutting operations

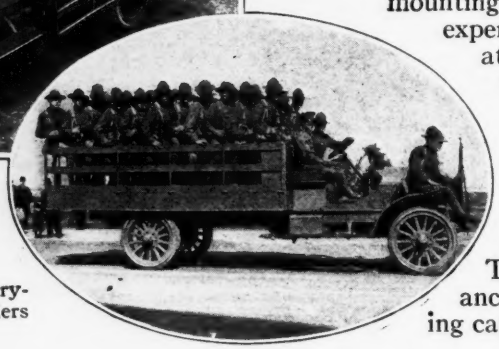
The kelp is cut four feet below the surface and is carried on deck by belts. Here it is crushed and stored in tanks

THE potash problem has been successfully solved. Our supply of raw material for its manufacture costs little and is practically inexhaustible. Near San Diego, California, undersea reapers are harvesting kelp, from which potash equal to about three times our annual importation from Germany previous to the war, is made by one concern; a second plant of about equal capacity has been established in the same vicinity, and a smaller plant installed by the Government is in operation. Just now, the manufacture of munitions requires all that can be produced, but we can obtain all that is required for ourselves and our allies.

The reaper cuts the weed four feet below the water surface when empty and six feet when loaded, the depth having been made a Government regulation for conserving the supply. Each of the three boats in the Hercules fleet takes about five hundred tons every working day, which means practically every day in California. The cut kelp is carried aboard the harvester on a continuous belt elevator to a mill, where it is crushed. The resultant sticky, gelatinous mass, deposited in the storage hopper, contains about eighty per cent water. This is pumped through a six-inch pipe. As soon as a capacity load is ready it is transferred by pumps to barges and thence into digestive tanks on the wharf, each of 50,000 gallons capacity. Subsequent processes deal with evaporation.



The seats are fastened to pivoted pipe uprights



At right: The truck carrying thirty-eight soldiers

the body are slatted and are hinged along their lower edges so that they may be swung down to permit of easy access to the seats from both sides of the truck. The novel body was invented by P. Landes, of Chicago. Except for the body, the motor truck shown is of the conventional type, with no changes necessary for the body mounting. It is considered by experts who are giving their attention to the question of transportation of troops to be a solution of one phase of the problem. The seats are so constructed as to allow of equal distribution of the weight over the wheels. This gives necessary balance and increases the carrying capacity.

Lift Three Floor-Planks and this Motor-Truck Carries Thirty-Eight Soldiers

EQUIPPED with a new type of body in which three of the floor planks may be raised to form seats, the novel motor-truck shown in the accompanying illustrations is capable of carrying thirty-eight soldiers sitting astride the three seats. By this method of seating, the soldiers are carried much more comfortably than would be the case were they obliged to stand on their feet on long overland journeys. It also permits every available inch of body floor area to be utilized and practically increases the seating capacity one hundred per cent over that of the ordinary type of body.

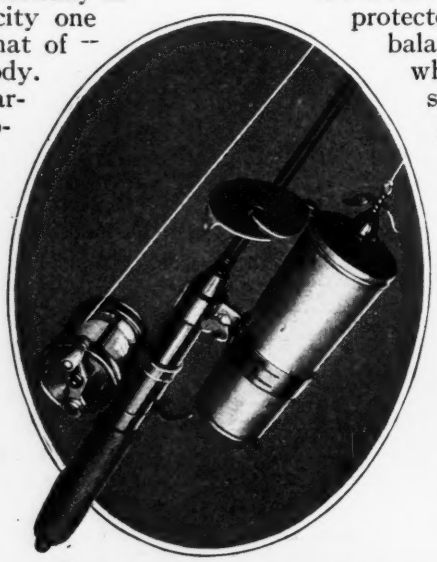
The three seats are carried on pivoted pipe uprights which can be locked in a vertical position when the seats are to be used. When not employed, they can be dropped in three minutes in such a manner that the top boards of the seats are flush with the other boards of the floor and form a flat platform or stake body which can be used for the transportation of freight, baggage or other supplies.

As shown, the sides of

Carrying Your Hook and Bait Where They Won't Drag

ONE of the fisherman's troubles, the snagging of the hook when walking through grass or brush, is eliminated by means of a protector which is attached to the pole near the reel. The hook with its bait is placed in the wooden carrier until the fisherman again reaches a place where there is space enough to cast his line without getting it entangled in the brush. The minnow or other bait is perfectly protected from mutilation, and catching the hook in the clothing is also avoided. The protector is light, and helps to balance the reel on the pole, which may be either of steel or wood. The protector is attached securely to the pole by a clamp which can be tightened by hand.

So far as casting goes, the fisherman may probably be inconvenienced a trifle at first by the additional weight of the carrier, but he will soon become accustomed to it. The carrier is large enough to accommodate a plentiful supply of bait and hooks of all sizes, even those used for deep-sea and salt-water fishing.



The hook and bait carrier clamped to the rod near the reel

Taking Photographs with a Concealed Buttonhole Camera

ONE of the quaintest and most ingenious detective cameras ever devised has been invented by A. A. Ciani, of East Orange, New Jersey. It resembles other cameras in only one feature, the lens, but even that feature is distinctive, so that it might be said Mr. Ciani's camera is without a counterpart. It is designed to be worn concealed under the coat, in the manner shown in the illustration. The protruding lens can be placed in the top buttonhole of the coat and photographs taken without anyone knowing it, by pulling a string hidden in the pocket.

Look carefully at the illustration showing the interior of the camera and you will see the shutter, partly operated, in a sector shape. The shutter appears on either side of the lens, in the opening just below the stem. Over the brass centerpiece, but not visible in the photograph, are two rubber bands which come into contact with the sensitized plate. By operating a knob on the front side of the camera, the centerpiece is turned and with it the plate. Four photographs can be taken on a plate, as there are only four teeth on the centerpiece. Every time a picture is taken the plate is revolved one-quarter turn. The shutter is operated by pulling the string concealed in the pocket.

The coat can be buttoned over the camera without inconveniencing the wearer and without exciting the suspicion of the one to be snapped.

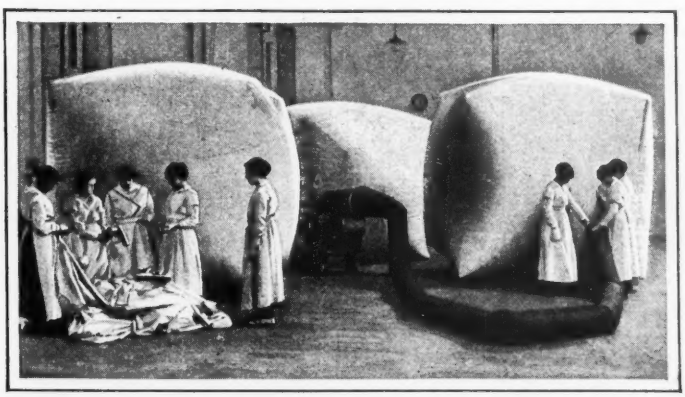
The detective camera is worn concealed under the coat. It is operated by pulling a cord which is led from it into the pocket

Inflating Huge "Pillows" as Targets for Airplane Practice

IN the days when balloons were more of a novelty than they are now, gas-bags were often made in the form of animals and human beings. The "pillows" which are shown in the photograph below may be regarded as a relic of that time; but they are used for a far more practical purpose than were the old man and animal-shaped balloons.

Nowadays, the heaviest naval guns are the only weapons able to decide battles. If there were no airplanes, these guns, too, would be powerless; they could not direct their fire tellingly without aid from a watchful man in an airplane. Hence, the fortunes of modern battles rest not only with sixteen-inch guns but in the last analysis with airplanes. That explains the stern struggle which is being waged for supremacy of the air.

The "pillows" shown herewith are really balloons roughly shaped like rectangular wings. Fighting in the air requires so much skill in an entirely new sort of marksmanship that the practical British have hit upon the scheme of systematically training their air fighters in shooting from speedy airplanes at these odd-shaped balloons. The balloons are not inflated with gas, as they rest on the floor, but with air from a big electric blower in the center of the room. Such a blower is found in every balloon factory for use in varnishing; for only a distended bag can be varnished or inspected.



The balloons are inflated and floated at the end of ropes. British aviators fire down upon them with machine guns

This Airplane-Camera Takes 750 Exposures with One Loading

THE greatest work of the airplane is to locate the enemy's strongholds and batteries and then map them. The multiple airplane-camera which the Allies are using—an American invention, by the way—can map the German lines with truly marvelous proficiency. Where, in the first part of the war, artist-observers were used to make pencil sketches as accurately and as quickly as they could, now cameras such as this one are employed to take thousands of photographs at the rate of one a second, if necessary.

The camera that takes 750 exposures with one loading

One multiple airplane-camera alone is capable of seven hundred and fifty exposures with a single loading. The secret of this great capacity lies in its use of ordinary motion picture film. It is constructed much like the ordinary film camera, with the exception that the turning of the film for a new exposure is accomplished automatically by the action of a set of gears.

The camera is placed on the airplane so that it will have an unobstructed view downward and slightly forward. One pull on the flexible cable, connected with the operating lever of the gears, winds up the previously exposed film, sets the shutter, makes the new exposure, and registers its number. A spring instantly brings the lever back into normal position ready for the next picture. This happens so swiftly that it is possible to make a continuous record of a flight. In bomb-dropping the camera is capable of taking pictures of the bomb in the air and at the very instant of explosion.

The Electric Stevedore. It Saved $18,000 in Labor Costs in a Year

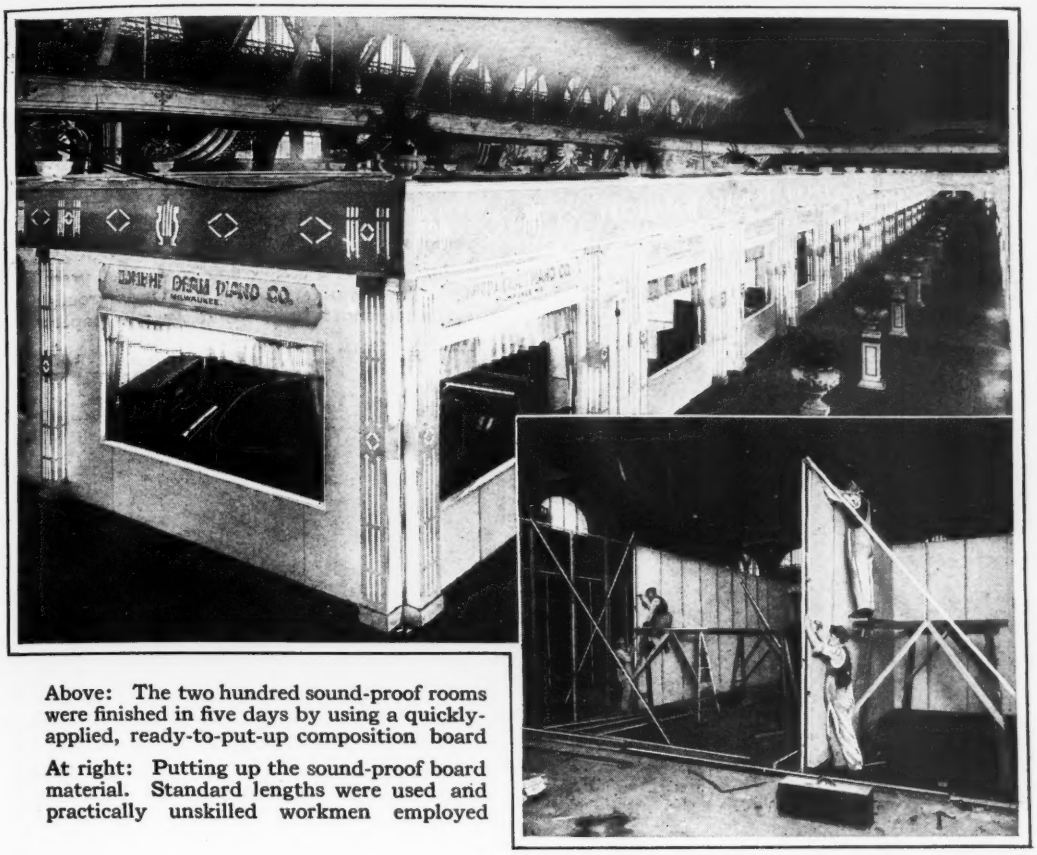
BELOW is pictured an electric floor-truck that does the work of ten man-propelled trucks. The pulling effort of the single front power-wheel is such that a railroad flat car weighing 33,900 pounds is hauled over sandy soil, carrying several interested observers.

The truck is the invention of J. E. Haschke, of Los Angeles, the man at the wheel.

The truck weighs but 1500 pounds. The motor is mounted on the yoke of a caster wheel, which permits the truck to revolve within its own wheel base; hence its peculiar usefulness upon congested floors. The wheels are rubber-tired.

A striking feature is embraced in the two levels of the truck, one but twelve inches from the floor. Any level of platform desired or demanded by warehouse needs can be provided. The truck will carry a ton on its back and tow several tons more on trailers; or it will carry several tons of iron, for instance, at a time over good streets.

It would take ten man-operated hand trucks to do the work of this electric truck



Above: The two hundred sound-proof rooms were finished in five days by using a quickly-applied, ready-to-put-up composition board

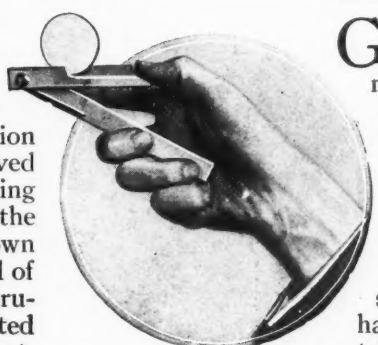
At right: Putting up the sound-proof board material. Standard lengths were used and practically unskilled workmen employed

Two Hundred Sound-Proof Rooms and How They Were Built in Record Time

WITH only five working days in which to erect two hundred sound-proof rooms in the large Coliseum in Chicago, the management of the National Music Show was confronted with an extraordinary problem. The difficulty was made all the greater by the impossibility of getting a sufficient force of workmen on account of the unusual war demands.

The problem was solved by the use of a composition board material which proved highly efficient in deadening sound. In fact, although the walls were very thin, as is shown in the photographs, no sound of the numerous musical instruments or of voices penetrated from one room to the next. The rooms also made a very handsome appearance. The auditorium built for concerts had much the appearance of a real auditorium built to stay.

The rapid construction work was made possible by the lightness of the material, and the fact that comparatively unskilled workers could put it in place.



By removing the thumb suddenly from the trigger the disk is shot up into the air or out, as desired

A Paper-Disk Flipper for the Youthful "Cut-Up"

GIRLS and boys alike derive endless amusement from a new device which throws a paper disk larger than a silver dollar from a hundred to a hundred and fifty feet into the air. The device is very simple in its operation, but flips the disks to a surprising height. You simply hold it in your right hand, with the thumb on the trigger member in the position shown in the illustration, then remove the thumb suddenly, and up or out the disk shoots.

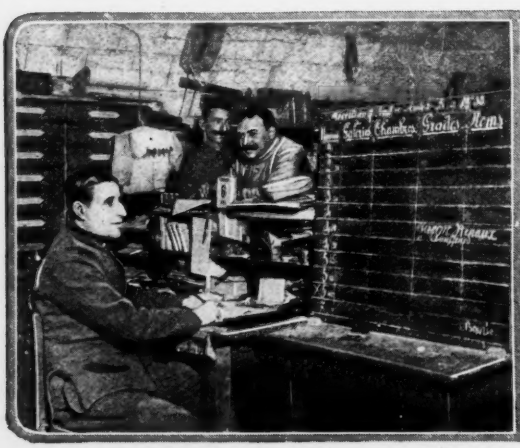
In the Grottoes Under the Battlefields

While the battle line sways back and forth over Verdun, in France, the military authorities live underground and carry on their business as usual

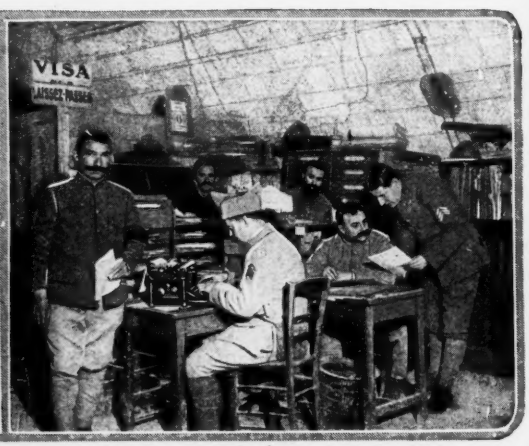
At left: The composing room and press of "L'Echo de Paris." Underground France must have its daily newspapers

French Official Photos

An underground fortress from which many a battle has been directed. There are numerous telephone connections and the commanding officer follows on his map the movements of the troops



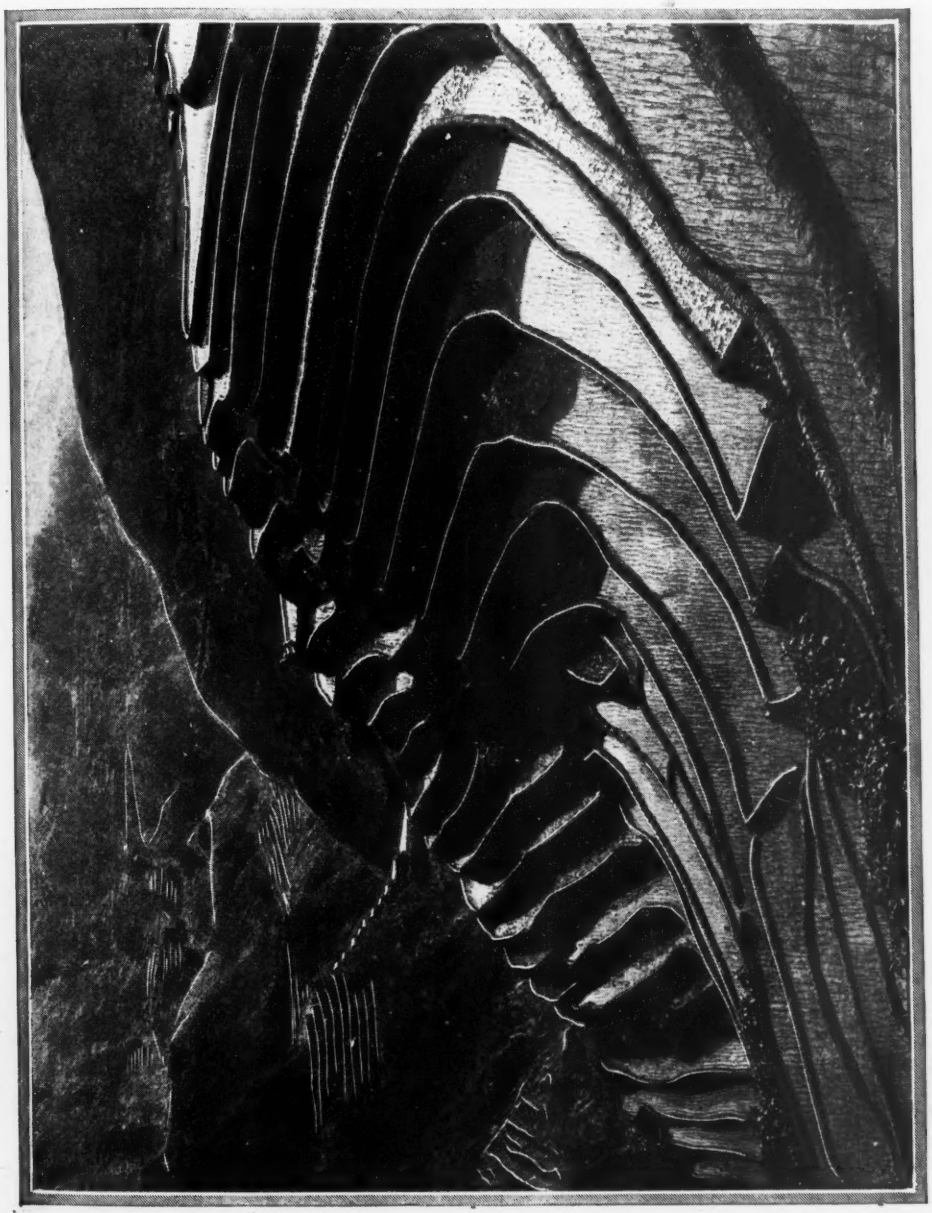
In spite of their cellar quarters strict records of all affairs are kept by the city officials



From this subterranean office all permits are issued for travel on the city streets

The Trench Farms of the Philippines

Notwithstanding the fact that rice grows best in valleys where the soil is rich and where it is kept flooded almost continuously until the grain matures, the Filipinos, who are as dependent upon rice as are the Japanese and Chinese, have succeeded in growing it upon mountainsides. There is of course a variety called "upland rice," which requires less water than that grown in the valleys, but even this is grown in marshy soil, kept wet by a trench system which holds back the rain and the irrigating streams preventing the water from flowing down the mountain and holding it in grooves in which the rice is planted. Huge water buffaloes are used to drag the plows and harrows through the mud. Sometimes these animals are blindfolded and made to turn wheels which elevate the water from the streams to the trench-fields. After the rice sprouts are set out, the water must be let off from time to time to permit weeding and cultivation, but it never destroys the ledges



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Remote from Man the Eagle Builds—But Alas!

A pair of young eagles, two months old, in captivity. They have just been captured from a nest on a distant mountain. Note the wild look in their eyes. This is never entirely lost

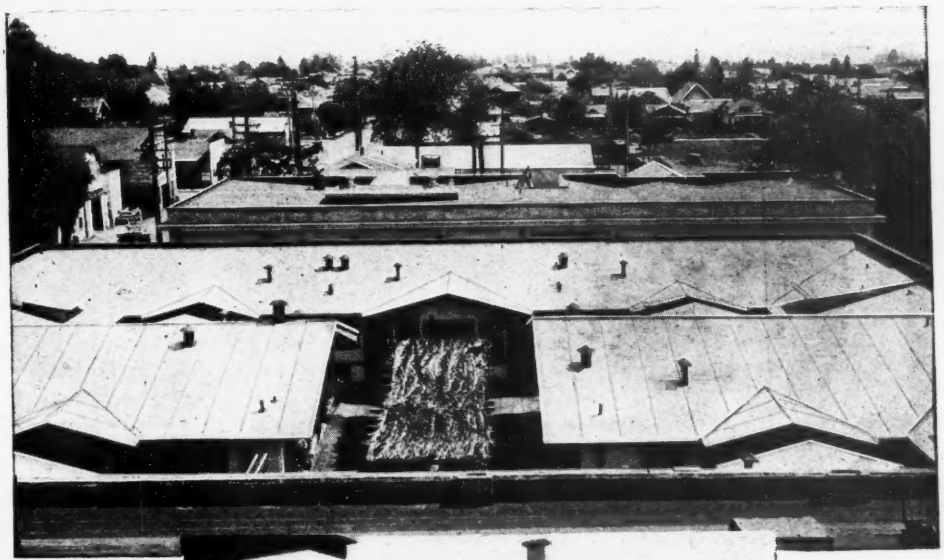
Risking his life to reach a nest. In Santa Clara Valley, California, searching parties capture the birds and despoil their nests

Bringing a young one to earth from its aerial roost. When two months old, eagles are ungainly creatures. They have not sufficient strength to use their wings and hence are helpless

At right: A searching party and motion picture operator returning to earth after a successful hunt. In addition to the danger of breaking their necks the hunters face the risk of being attacked by the mother bird

Bungalows on the Roof of a Post-Office

The post-office occupies the ground floor, and the bungalows take up the space that would otherwise be the second floor. The nine bungalows rent for $25 a month each



Above: The top of the post-office bungalow colony. The windows seen on the second floor as one looks at the building from the street are the windows of the bungalows

The bungalow residents have the advantage of being downtown and at the same time of living in an atmosphere far removed from that of an ordinary apartment house

And the Inventors Never Cracked a Smile

Rockers more than ordinarily accommodating. The one at left above is a veritable rocking horse. The other has an additional rocker to prevent it from rocking

One of the fountain pens above was invented in 1847. The ink was contained in the bulb section and sent down to the point by pressure on the piston rod. Note the two-pointed pen and the pen with leather finger loops

The chair below is a life-saving device made of zinc. When the ship sinks you float off into the water still seated and enjoying your paper and cigar

Even musical instruments have not proved inviolate. Here we have a violin-horn, a two-stringed affair, and a gourd-like mandoline which resembles an Indian club

Patented 'way back in '57, for floating horses across streams. Four bladders, inflated with air, are strapped to the horse to buoy him up

To get those highboots of '61 off, bootjacks were used. The chair has a kind of oarlock for this purpose and the shoe has a brass projection which slips back into a groove in the leather heel when not in use

France's Tank Contribution to the War

The tank all France is talking about. It is fitted with heavier guns than the British tanks, but it has not made any particular name for itself in the fighting so far. The usual type of caterpillar drive is used

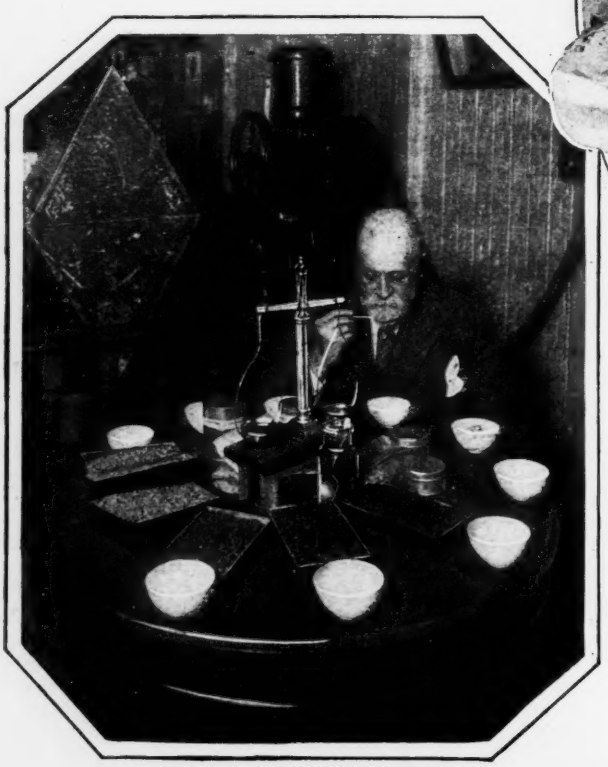
Major Bossut and Lieut. Boucheron and the new tank. The photograph was taken just before the tank broke down inside the German lines. Rather than see it fall in enemy hands Major Bossut blew up the tank killing himself

Photos © Underwood and Underwood

They Earn Their Living Simply by Seeing,

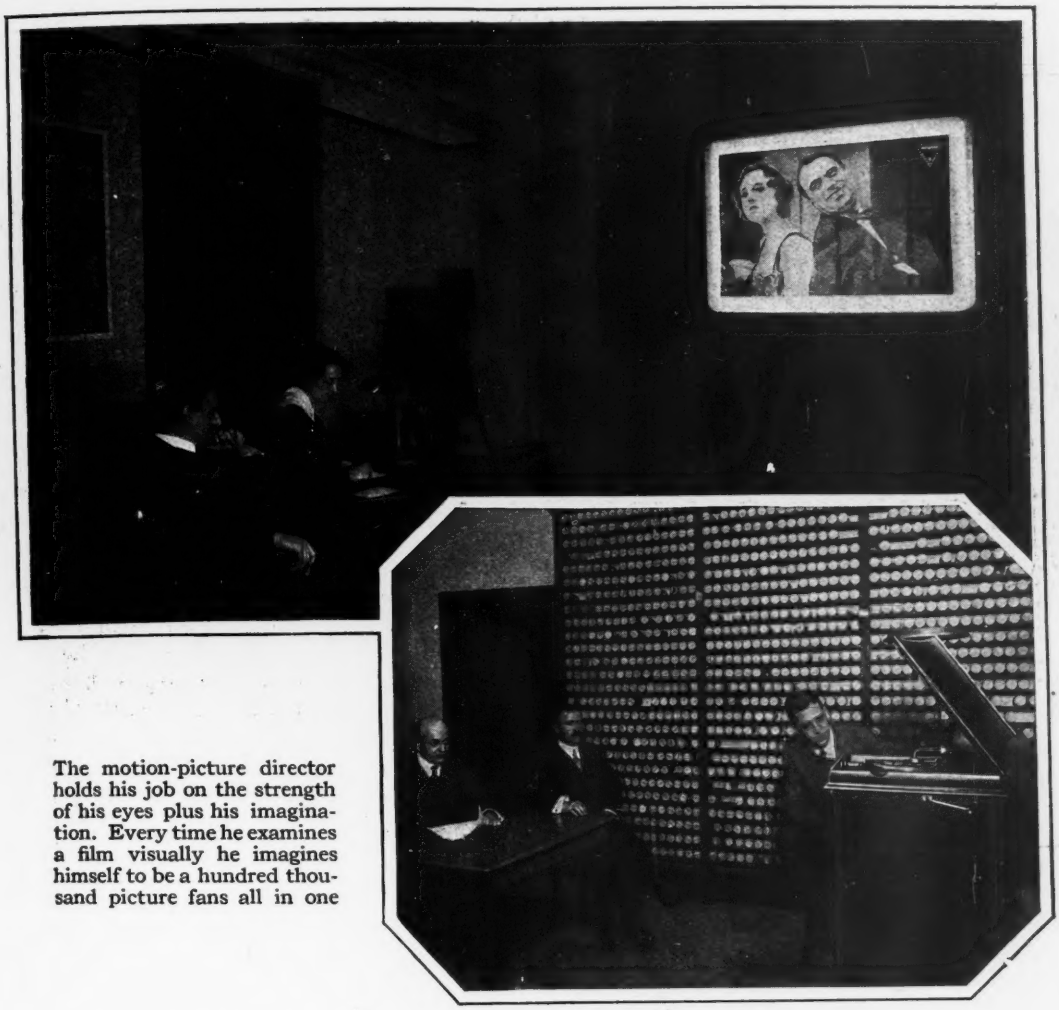
The perfume smeller tests the most delicate aromas with his critical nose and places a value upon them. It is interesting work, provided the perfumes are good

Contrary to expectation tobacco is sampled by the sense of touch. If the leaf does not feel right to the sensitive finger-tips of the expert it is rejected



The coffee taster is a half brother in trade to the tea taster. He never drinks coffee; he tastes it. His beverage is made a sip at a time in a porcelain coffee pot on the French drip method

Hearing, Smelling, Tasting and Feeling



The motion-picture director holds his job on the strength of his eyes plus his imagination. Every time he examines a film visually he imagines himself to be a hundred thousand picture fans all in one

With ears trained to detect errors, some men are expert listeners. Singers as well known as Caruso are sometimes obliged to abide by the verdict of a listening jury, such as the one shown above

Tea tasters are employed by every first-class tea concern and by the customs officers of all the Governments. Some of the tea experts chew the leaf, some judge by smell and some sip the beverage

Cats? Demons? No; Just Chunks of Wood

The curio shop of Moses Ogden, of Angelica, New York, with some of the finished curios in view and a pile of promising material at the side of the house. In his tramps through the woods Mr. Ogden discovers all sorts of queer faces and figures peering out from brush and branches of trees

The combination figure at the left is suggestive of a poultry yard. In the center is a snake on the lookout for eggs. Where the ordinary person sees only a knot of wood Mr. Ogden sees a queer-looking dog with an owl's head, or a gnome true to story-book description, or something else uncanny

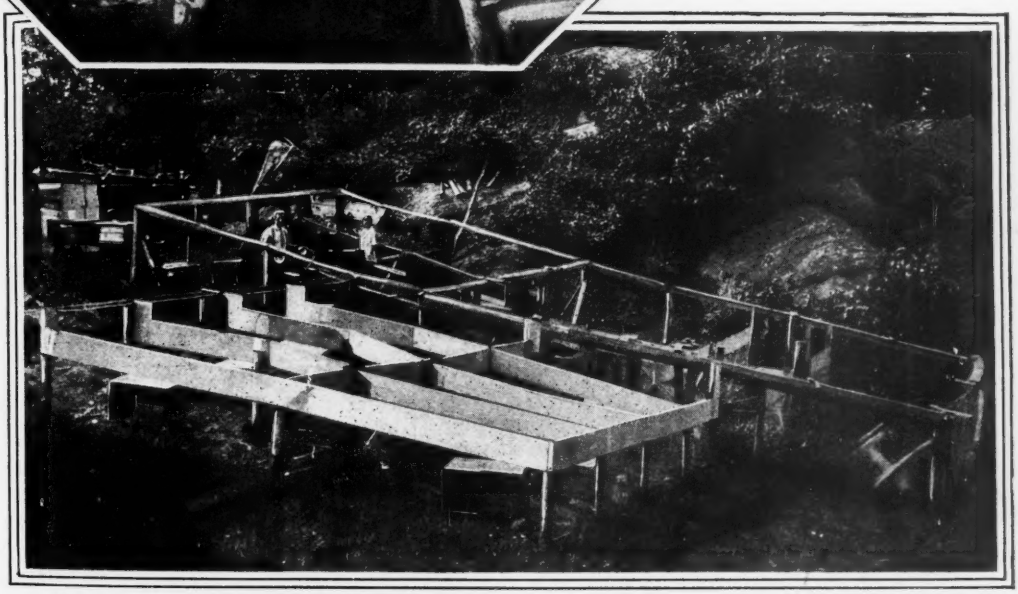
Some of the curious images appear just as Mr. Ogden found them in the woods. Others suggestive of the hapless creatures that Dante saw in the Inferno have been shaped with the penknife. There are no particular names for these dignitaries and no special uses except as "ornaments"

There Is Pleasure as Well as Profit in Skunks. Your Next Year's Fur Coat May Come from a Farm Like This

Photos by Brown and Dawson

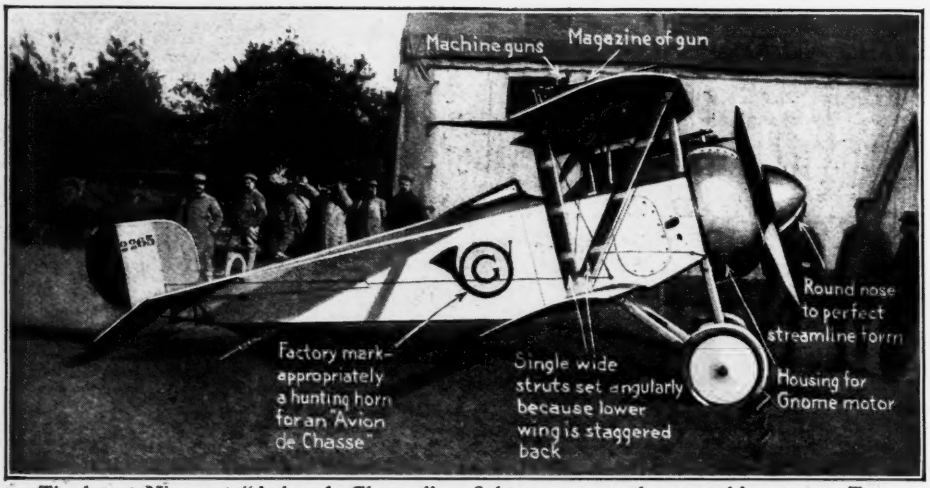
Above: Skunks make admirable pets when they are young. They are as playful and as harmless as kittens. Only the older ones need to be handled with care

The striped skunk is the only one that makes money for the breeder. In return for good care and feeding its fur becomes exceptionally thick and glossy

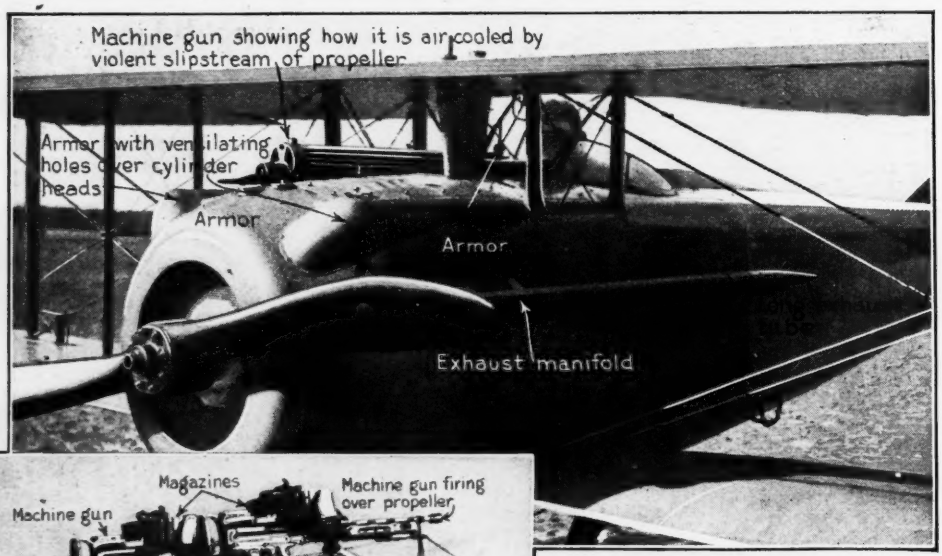


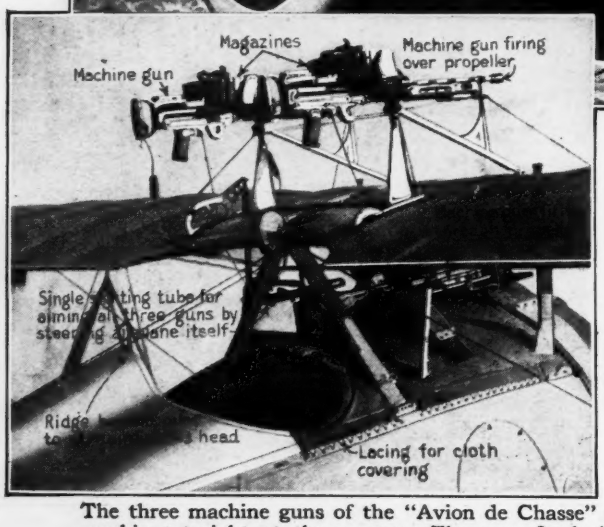
The skunks are given as much freedom as possible in wire pens. They are great diggers, consequently they have to be watched continually and the pen walls constantly renewed

The New Eagles of the Western Front


Machine guns
Magazine of gun
Round nose to perfect streamline form
Factory mark—appropriately a hunting horn for an "Avion de Chasse"
Single wide struts set angularly because lower wing is staggered back
Housing for Gnome motor

The latest Nieuport "Avion de Chasse," or fighter, mounts three machine guns. Two on top of the plane fire over the propeller and one beneath the upper plane fires through the propeller. The perfect streamline body, the small wings and rudders and the big propeller with a hood in front enable the machine to travel at 120 miles an hour


Machine gun showing how it is air-cooled by violent slipstream of propeller
Armor with ventilating holes over cylinder heads
Armor
Armor
Exhaust manifold



French Official Photos

The new fast armored Farman fighting plane. Only one machine-gun can be carried because of the armor's weight. Another view of this machine appears at the top of the next page. The armor over the cylinder heads of the engine is perforated so that cooling drafts may enter, the strong slipstream from the propeller entering through the circular opening in front, passing through the radiator and finally emerging through these holes

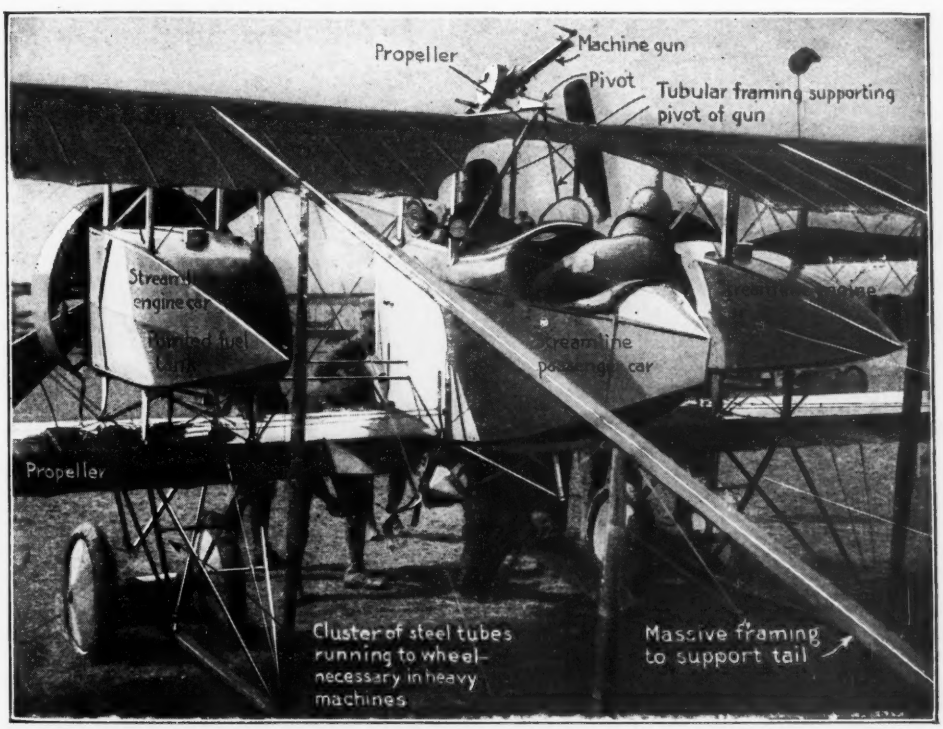
The three machine guns of the "Avion de Chasse" are aimed by pointing the whole machine straight at the enemy. They are fired simultaneously by the single pilot. Ordinary machine guns are used, evidenced by the useless rear handles and pistol grips

Armor Appears on the Airplane

On this and the preceding page we present pictures of the newest French airplanes—an unarmored fast fighting Nieuport "Avion de Chasse," a fast armored Farman biplane, and a heavy weight-carrying Caudron, all of which are in active service

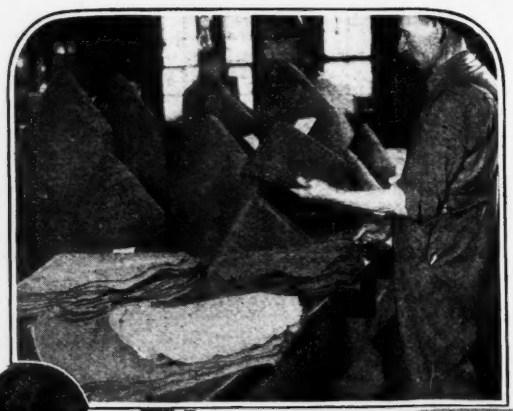
French Official Photos

In the new armored Farman biplane the exhaust is carried far behind the pilot through a perforated tube. A certain amount of muffling is also thus attained. The machine gun is obviously cooled by forced draft produced by the violent slipstream of the front propeller. The armor leaves much of the really vital portions of the machinery necessarily exposed, such as part of the radiator; still it increases safety



Either one of the pilots of the two-motored Caudron may stand up in turn and fire the machine-gun, the man in front rearwards, and the man behind either ahead or abeam

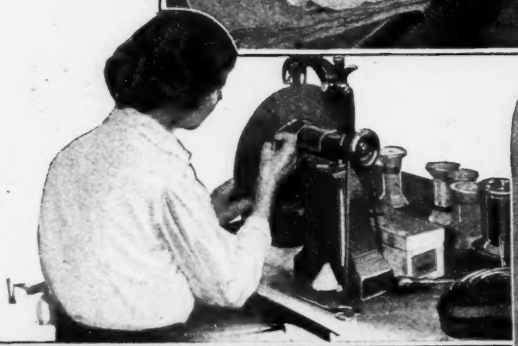
What's Your Hurry? Here's Your Army Hat—and the



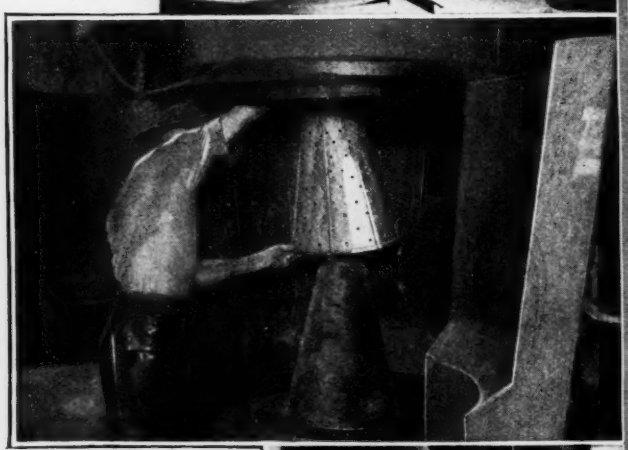
Below: Sewing the sweat band on a finished hat. A machine does the sewing in one-half the time required by hand operators

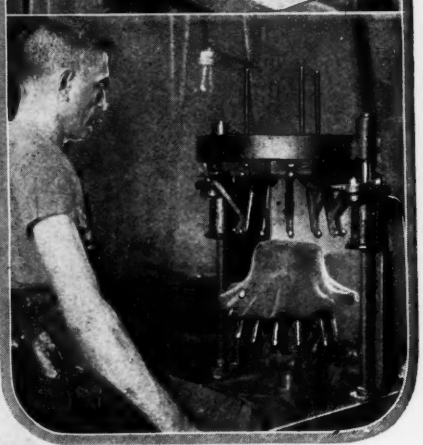
The inspection table. After the hats are shrunk and dyed they are examined before being sent on to the forming room

Below: The cone of fur as it is removed from the blowing machine. It is very soft and delicate requiring careful handling



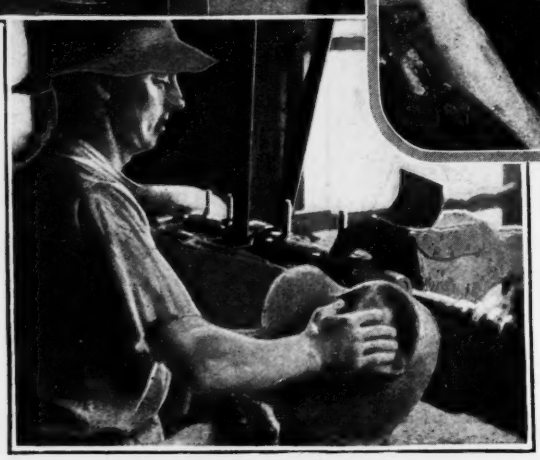
Photos © Brown and Dawson





The first process in making an army hat is shown above. The metal shaping cone is placed over the fur and revolved at great speed

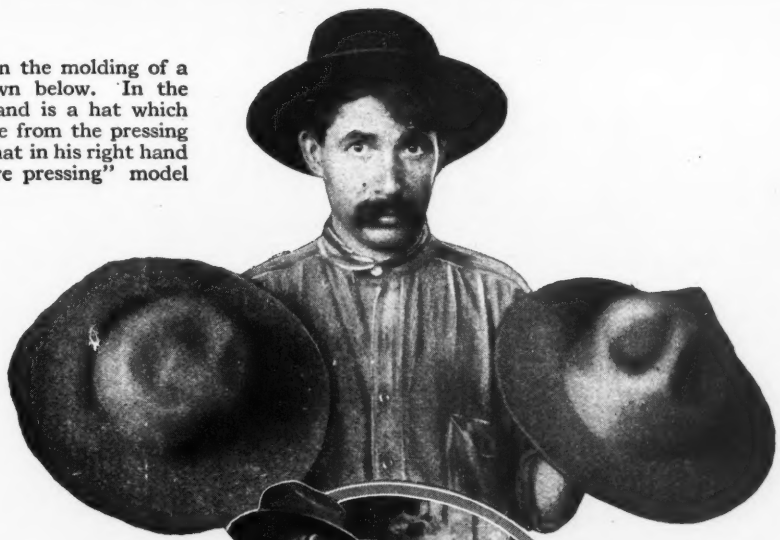
At right: Making the crown and brim smooth by putting the hat through a series of grinding rollers covered with fine emery



Above: The brimming machine which stretches the edge of the hat until it resembles a brim. Shellac gives the stiffening

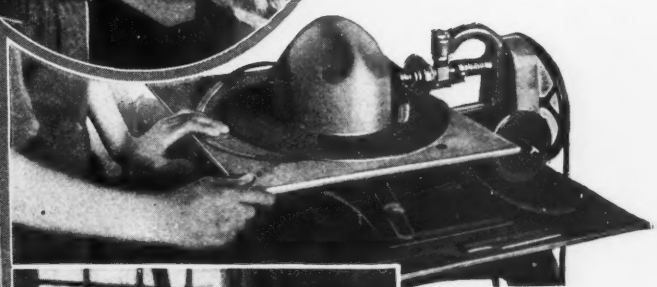
Processes Through Which It Passed in the Making

Two stages in the molding of a hat are shown below. In the man's left hand is a hat which has just come from the pressing mold. The hat in his right hand is the "before pressing" model



At left: Five ounces of raw fur are used for each hat. The scales weigh to within one six hundredth of an ounce. Most of the weighing is done by automatically operated machinery

Photos © Brown and Dawson

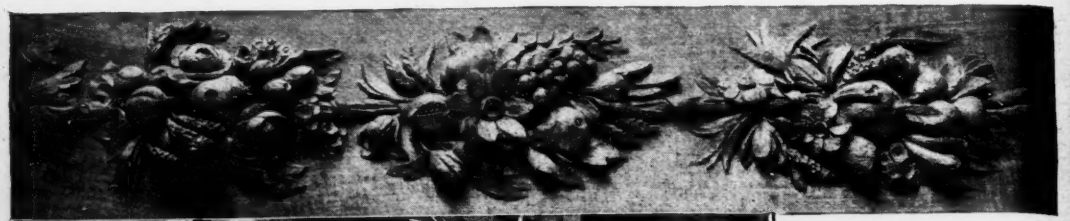


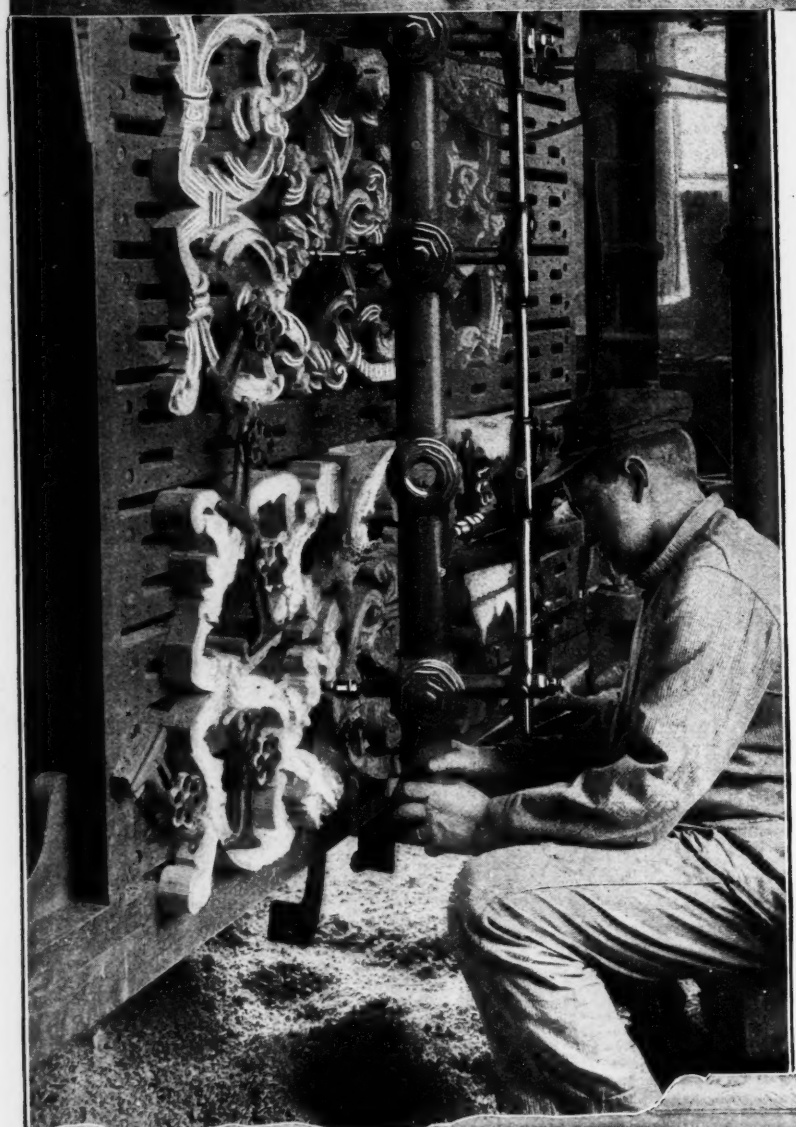
Forming the hat in a steam-heated press. A steel die in the lower part of the mold gives the finished hat its size and desired shape

Above: Cutting the brim of the hat to a uniform width. As the work is done by machine there is no chance for error

The hats are dipped in shellac, then passed upward through rollers which wring out the surplus liquid

Wood Carving by Machinery—A Novice Can Do It





© Brown and Dawson

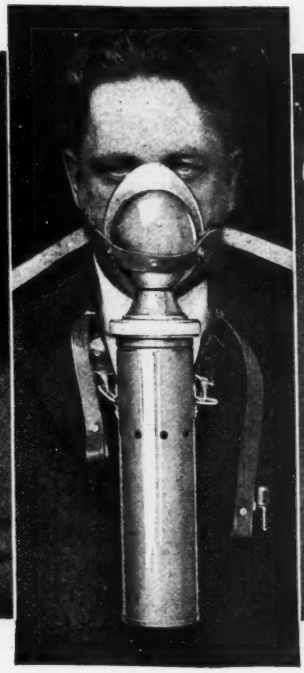
Formerly when an elaborate carving had to be duplicated many times, each duplication had to be worked out separately. To-day the duplications are made five at a time

The original carving shown here was made in plaster of Paris. The reproductions in wood were made by a machine which consists of a battery of four rotating drills and a stationary rod which the operator moves over the outline of the pattern. Every movement of the master rod is duplicated by the four repeating drills

When a very large number of reproductions are to be made of a certain design, the original is generally made in wood. With this machine one novice can do the work of five skilled men

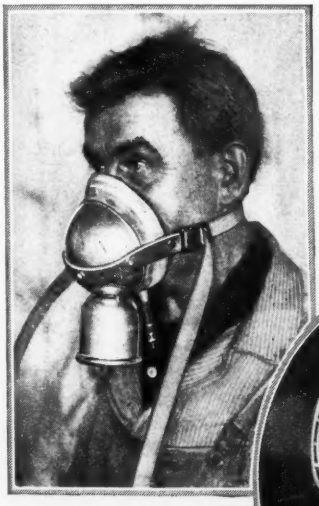
New Fashions in Gas Masks

The mask which is in use at the present time by the English and the French. To the soldier in the trenches the gas mask is as important as his rifle



Worn for gases which are poisonous but which do not affect the eyes. The mouth and nose are pneumatically sealed by a rubber-faced cushion

Impervious to smoke and flame, the mask is made of asbestos and is worn by rescue squads in fires and explosions. An entire suit of asbestos accompanies it



Mask used by our submarine sailors when salt water reaches the electric storage batteries and chlorine gas is generated in consequence

Below: A helmet built especially for workers in tobacco plants. Heavy irritating dust is thus prevented from reaching the lungs

Worn for protection against chlorine gas by workmen who are constantly exposed to the gas in chlorinating plants

Operating Upon Trees

When trees get sick or are damaged they need the tree surgeon

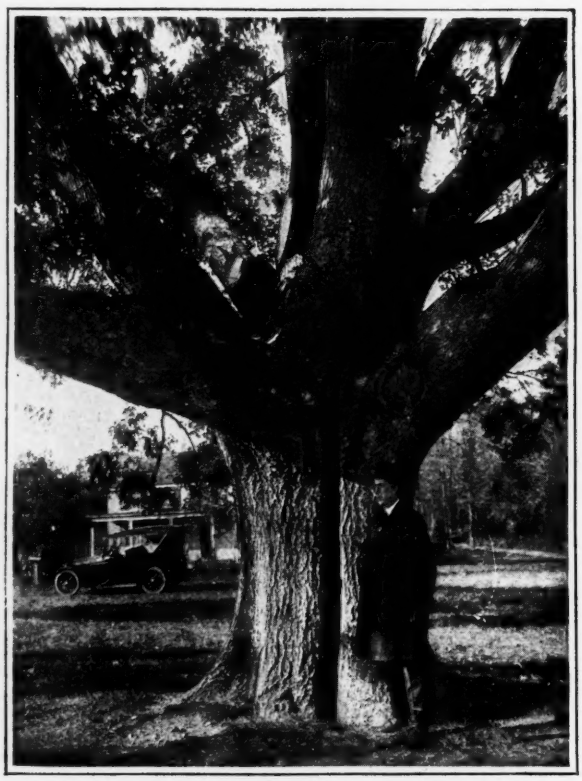
Photos © Brown and Dawson

Like a dentist he removes all decayed matter from a cavity

THE science of tree surgery is but twenty years old. Yet it has already become of inestimable value. It is saving thousands of shade trees and fruit trees each year. All trees, and sweet-sapped trees especially, are liable to fungus disease. The fungus is a parasite by nature and sends little, thread-like tentacles into the woody tissue. These travel from cell to cell, disintegrating the internal structure of the tree. The result is what we call "rot." When fungus starts in a tree it never stops unless arrested by human skill. The tree surgeon alone can destroy the disease.

The accompanying illustrations show how useful tree surgery can be. In one of the illustrations is shown steel cables strung between the upper branches so that the weakened trunk would not be unduly strained under the action of the wind. This was a comparatively easy task, but real tree surgery is not simple. It is a difficult and exacting art. Some trees require a combination of bolts and lock-nuts, reinforcing rods and cross-bolts with lock-nuts above the crotch. Others need a combination of bolts and criss-cross bolts with lock nuts, tortion rods and chains, and still others call for iron straps, tortion rods, iron backbone and ribs in addition to chains and lag-hooks higher up.

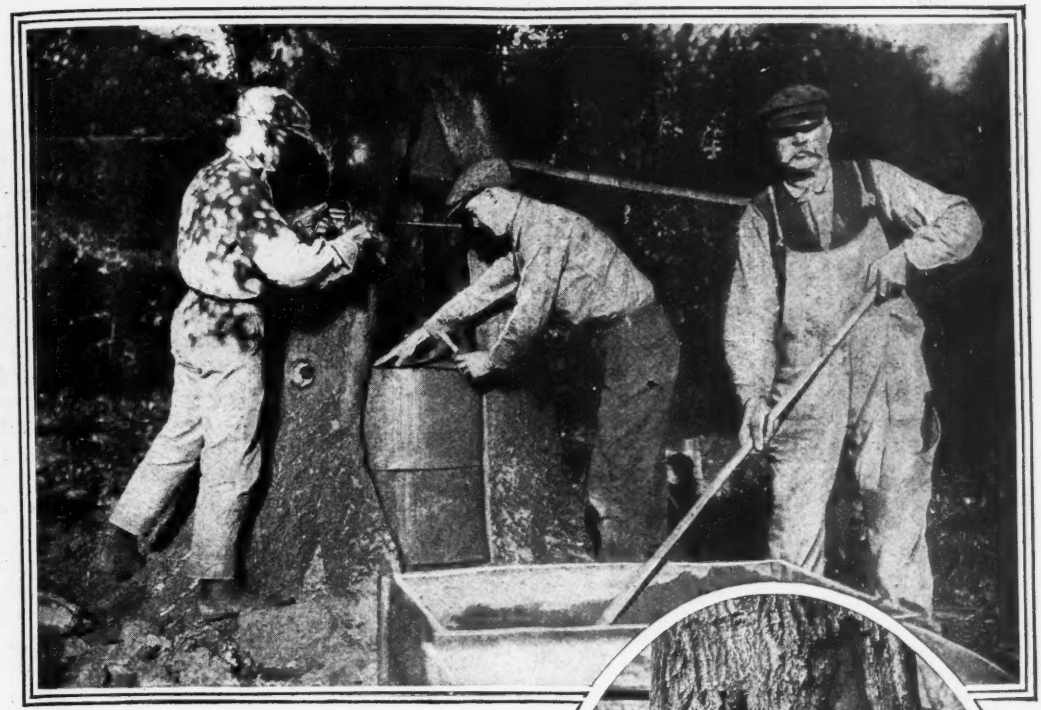
Another illustration shows large cement fillings built up in separate block sections to allow swaying of the tree. In a very short time, the edges of the cut "heal" to the cement. That is, the soft living tissue solidifies upon the cement, making a tight joint which is waterproof. Often the bark at the sides of the patch gradually grows together closing over the cement. Young trees are not so difficult to doctor. One of their chief enemies is the bore worm. The tree surgeon, upon discovering a worm hole in the tree drills into it with a stiff wire, kills the worm and fills up the hole with tar.



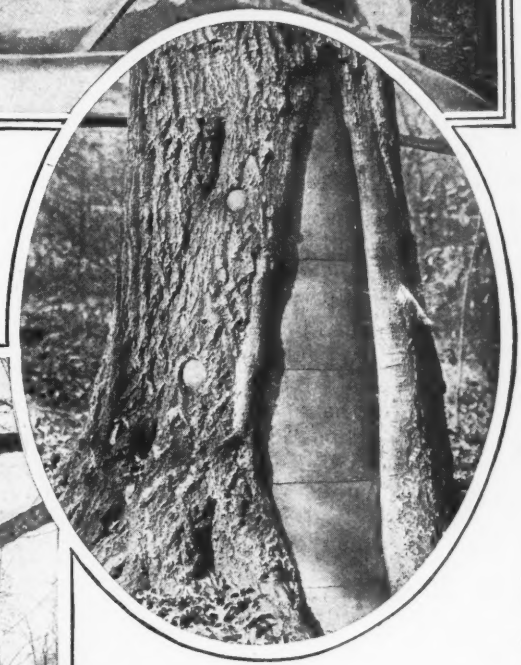
A sick tree on the way to health. The cement filling reaches almost to the heart of the tree

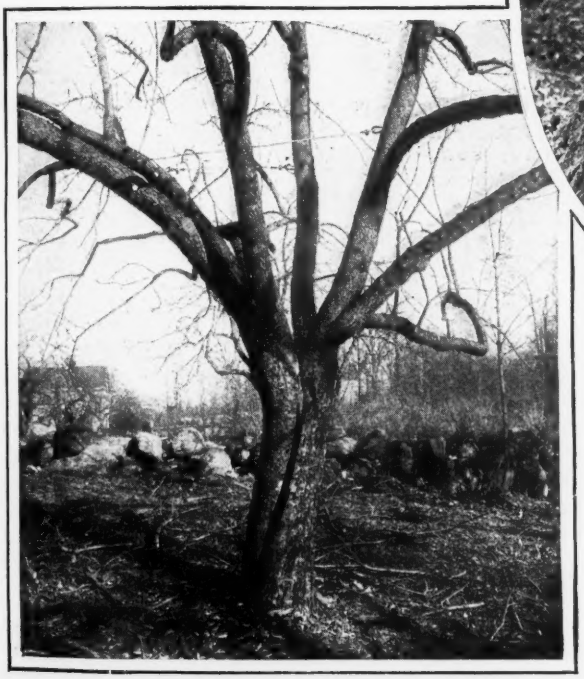
But tree surgery is not merely a matter of filling cavities. Unless the work is scientifically accurate and mechanically perfect, it fails. Since decay destroys the structural strength of the tree, this strength must be restored by mechanical means.

Tree Surgeons at Work



Above: In filling a cavity the cement is laid in sections. This prevents the cracking or breaking of the filler when the tree sways in the wind





Above: Healing soon takes place and the cambium (new growth of bark) rolls gradually over the cement filler, sometimes completely concealing the patch

Left: A tree whose trunk split asunder. The doctor has inserted eyebolts and has drawn the branches together again by means of wire cables

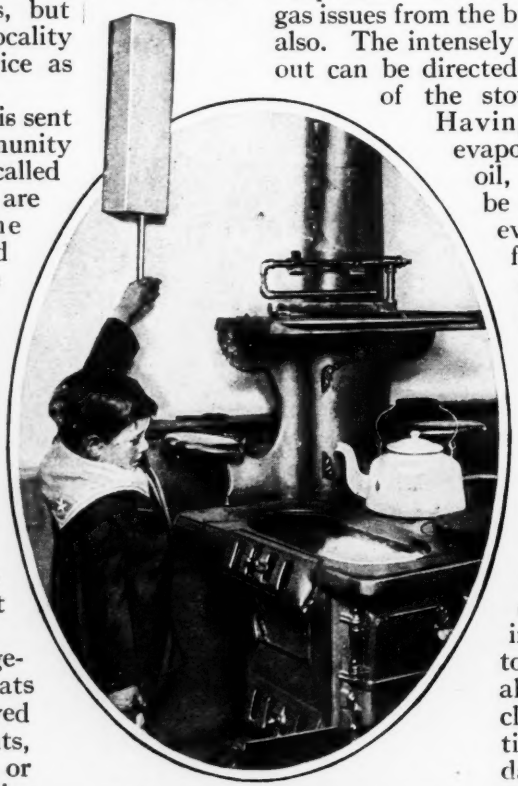
The food barrows of London serving meals ready prepared and hot or cold to patrons of the community kitchen

A Kitchen on Wheels—the School Children Serve the Meals

IN St. John's Wood, London, the community service idea has been worked out to a nicety in relation to the kitchen and the serving of meals. Not only are housewives and others relieved of the duty of cooking the meals, but school children of the locality are pressed into service as cooks and waiters.

Every day the food is sent out from the community kitchen in what are called food barrows. These are wheeled through the streets and are stopped upon demand at the doors of prospective customers or old patrons. The food is carried in big aluminum pots and vessels which fit into a metal container filled with water which may be boiling hot or ice-cold, according to whether the food is to be served hot or cold.

Soup, coffee, and vegetables of all kinds, meats and desserts are served in any desired amounts, in individual portions, or enough for an entire family repast.



The kerosene passes drop by drop into the pipes over the flames

Change Your Coal Stove Into a Gas Range

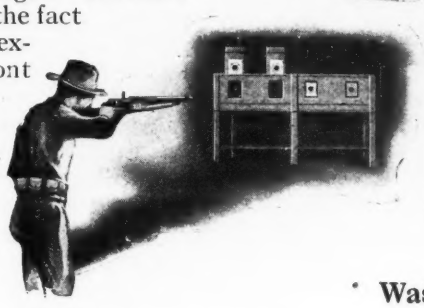
WHEREVER kerosene oil is to be had, it is possible to convert your coal stove quickly into the decidedly more convenient gas range. A new attachment put on the market for this purpose is sufficiently simple for the least initiated to operate. A kerosene tank is screwed to the wall and the clamps on the burners are attached in the stove's fire box. From then on you will forever be free of the bother of both the coal bucket and its colleague, the ash pan!

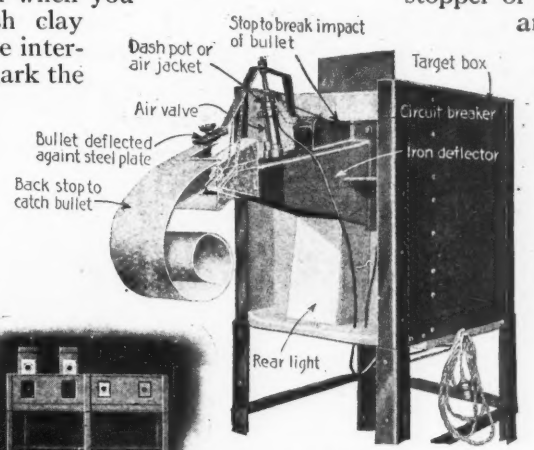
The attachment is in reality a miniature gas plant. After filling the tank with kerosene oil, the valve is opened until the oil begins to trickle from the burners. The valve is then closed and the little oil previously placed in the iron pan under the burners is lighted. The heat from the burning of this oil causes that in the pipes above it to evaporate. As soon as this happens, the gas issues from the burners and it is ignited also. The intensely hot flames then given out can be directed on to whatever parts of the stove they are needed.

Having once started the evaporation of the pipe oil, the tank valve can be again opened. Whatever oil thereafter flows from the tank will evaporate in the red-hot pipes over the burners and be converted into gas. One drop of oil will produce an immense amount of gas; obviously, then, the tank will be exhausted very slowly. The fact is that not more than two cents' worth of oil need be used up in an hour, according to the inventor, who also emphatically declares that there is positively no element of danger in the device. "A little child can manage it," he says.

Did You Hit the Target? This Target Answers

ONE of the objections to rifle shooting from the standpoint of the spectator is that you can't see what is going on—the results of the shot, as you can when you watch shotgun shooters smash clay birds. To make the game more interesting to the spectator and to mark the target for the shooter without the necessity for walking out and retrieving the target or hauling it in on its carrier, Frank C. Reed, of Springfield, Ohio, has designed and put on the market what he terms the "spot shot" target. He takes advantage of the fact that if you extinguish all front lighting on a paper and put a strong light behind it, any perforation will show plainly in silhouette.





At left: A circle of light shows the bullet hole. Above: The details of the lighting device

In a strong iron box he puts front lights of suitable strength and arrangement to best light up the small cardboard indoor miniature rifle target, and protects these as usual by a steel plate.

Behind the target, which slides into grooves formed in the box, is a funnel-shaped passage leading back from the target to a movable plate at the end of an arm that controls a circuit breaker for the light circuit and for the normally extinguished light behind the target. This arm also operates a dash-pot or air-jacket that slowly draws the arm and its plate down to place again, breaking the circuit for the backlight as it does so, and again lighting the front lights.

When the bullet passes through the cardboard target in the holder, it continues on down the funnel, striking the steel plate and driving it and its arm into the air. The bullet then continues into a curved bullet-stopper of heavy steel and comes to rest.

Instantly, by the action of the arm driven violently upward by the bullet, the front lights are put out and a strong light from the rear reveals the target hole.

Washing for Gold in the Clayey Soil of the Guianas

IN working for gold in the Guianas, where sluices are impossible because the soil is clayey, the ground is worked with a "Long Tom," a puddling-box about eight feet long. The tom is filled with the gold-containing mass by a spade-man and a hoe-man. The larger stones collect against the perforated iron plate at the end of the box fitted with riffles through which the dirt-bearing water flows. The worker throws the stones high in the air, watching for a glitter of gold. To make sure, he catches them again and perhaps repeats the trick, which seems simple but really demands the highest skill.

Before dropping it into the "Long Tom" the washers toss the sand high in the air to catch the glitter of the gold

© Int. Film Serv.

The latest fashion in helmets — the screen-like visor which protects the eyes. It can be raised and lowered

A Screen Visor Is Added to the French Helmet of Steel

A REVERSION to primitive methods has been one of the remarkable features of this war. In our school days we learned that soldiers gave up the use of armor because they could fight better without it, and because it afforded no adequate protection after firearms became available. Now we must change our minds all over again, for trench helmets of steel are considered absolutely indispensable and even chain armor is used.

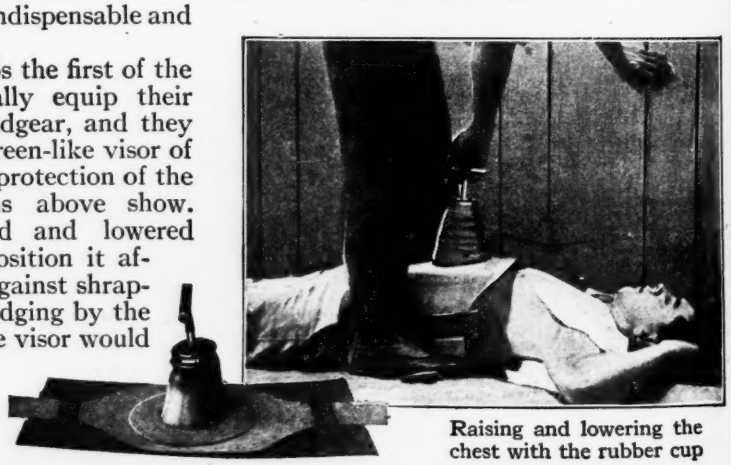
The French were perhaps the first of the warring nations to actually equip their men with bullet-proof headgear, and they are the first to attach a screen-like visor of steel to the helmet for the protection of the eyes, as the photographs above show. The visor can be raised and lowered and when in the latter position it affords the eyes protection against shrapnel and shell splinters. Judging by the size of the perforations, the visor would hinder rather than assist the soldier when he is required to take accurate aim in firing.

Creating a Vacuum to Induce Artificial Respiration

A NEW type of resuscitating device which commands attention because of its novelty if for nothing else, has been invented by H. E. Acklen, of Memphis, Tenn. A rubber cup which creates a vacuum when operated after the fashion of a pump is the inventor's method of methodically raising and lowering the patient's diaphragm to induce breathing. Whether the rubber cup is strong enough to raise the chest and lower it, is the question upon which the practicability of the apparatus rests. At first thought it would seem as if the cup would have all it could do to raise the leather pad and the skin, to say nothing about the chest.

But if there is a question regarding the raising capabilities of the device, there is no question but what it is sufficiently strong to depress the chest. The handle enables the operator to exert a considerable pressure on the instrument. The vacuum device is secured against the chest by straps which are held to the floor under the operator's feet, as the illustration shows. The up and down movement of the device may be regulated by the straps under the feet of the operator. They also hold the patient down.

If the apparatus proves practicable it will doubtless be the quickest method yet devised for resuscitating the all-but-drowned. The pressure on the abdominal walls will force the water out of the stomach.



Raising and lowering the chest with the rubber cup

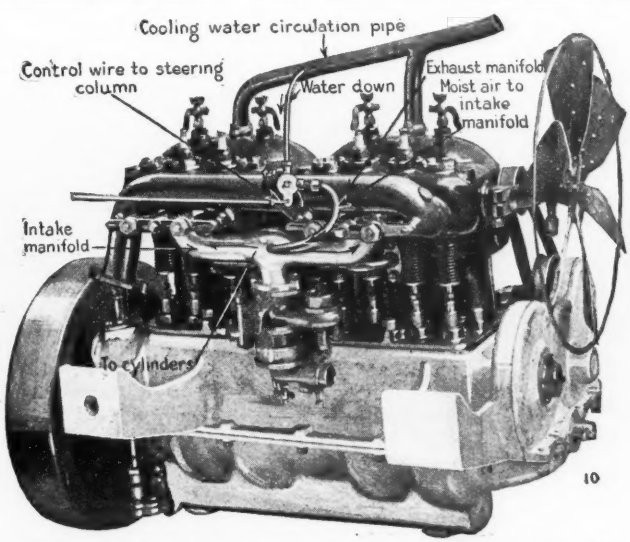
Unwashed Sponges Are Fifty Per Cent Dirt

MANUFACTURERS who use large quantities of sponges have found that in buying them at a fixed rate per pound, they were paying too much for plain earth. They now require every carload of sponges to be analyzed. Samples are taken from each car and weighed. They are then put through a standard washing process and weighed again. Fifty per cent impurities have been found in many cases.

Using Live Steam or Vapor to Save Gasoline

THE device shown below is designed to reduce the consumption of gasoline by introducing live steam or vapor into the intake manifold of an automobile engine, especially on those carburetors which are difficult to adjust properly. The apparatus consists of a small cylindrical chamber screwed into the exhaust manifold, which contains a rotary valve controlled by a cable from the driver's seat. Hot exhaust gas is introduced into the chamber through a port in the rotary valve, where it meets a small amount of water drawn through a pipe tapped into the water-circulating system. Meeting the hot gas, the water is turned into steam and thence fed to the intake manifold through another pipe where it mixes with the fuel from the carburetor to form a more economical mixture. The amount of water entering the rotary valve is controlled by a small needle valve at the top.

Besides producing a more economical mixture, the presence of a small amount of water vapor in the cylinders tends to soften the deposit of carbon and retard additional formation.



The principle of the gas-saver involves moist air heated from exhaust gases and introduced into the manifold

The evaporation-cooled refrigerator is the Californian's answer to the desert's blistering heat

The Imperial Valley Is Off the Ice-Man's Route: Hence the Burlap Cooler

YOU can fry an egg on a rock in the Imperial Valley of California by letting the sun do the cooking, but a Rockefeller couldn't afford the price of a tumbler of cracked ice. But this does not mean that the Californians have to do without food refrigerators and various cooling devices. J. G. Hill, of Mecca, near the Salton Sea, has contrived an evaporation-cooled refrigerator which requires no ice.

It has a wooden framework, and includes numerous shelves. Several layers of burlap cover it. A perforated tin can at the top is connected with hose which sprinkles water over the entire burlap surface. The evaporation keeps the interior cool.

Surveyors climbing to the top of a precipitous cliff in Alaska to take observations

Risking Lives for the Sake of Precision in Government Surveys

ONE of the most difficult and exacting tasks of an extensive land survey made by the United States Coast and Geodetic Survey, is the selection of points from which observations may be taken. In heavily wooded country it is necessary to climb the tallest trees or to raise poles taller than the trees, from which the distant horizon can be seen and such observations made as may be practicable. In mountainous country such as Alaska, the surveyors have to face death for the sake of precision, climbing the highest peaks in order to obtain an unobstructed view of the horizon.

Why risk one's neck to make a simple survey? Because when great precision is desired it is impossible with chain or tape to survey a region in which there are bays, rivers, mountains and other natural obstructions. To overcome these difficulties the method called "triangulation" is employed. It rests upon the simple proposition taught in every school that if one side and the angles of a triangle are known the remaining sides can be computed. It is to obtain the first side of a triangle, or base line, that the surveyors climb the highest trees and mountains. So painstaking is their work that in a survey of one hundred miles the error is often less than five feet.

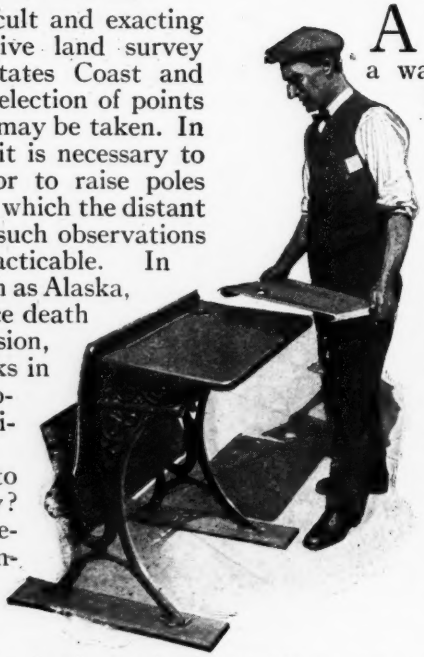
The accompanying photograph shows a Government surveying engineer climbing a steep cliff in Alaska, prior to establishing a base line. On his back he carries the necessary surveying instruments. On the top of the cliff stands a companion engineer who undoubtedly scaled the cliff without assistance. The feat is made safer for the second man because of the rope which has been lowered to guide him in his ascent of the nearly perpendicular surface.

If he is to measure a great distance from the top of the cliff the only instruments the engineer will use will be heliotropes (not helioscopes) by day and powerful lights by night. The heliotrope is a small mirror so arranged that it reflects the sunlight in a long line toward the observer.

Keeping School Desks Presentable with Cardboard Covers

A JANITOR of a school in Pasadena, Cal., has found a way to keep the desks in his classrooms looking bright and presentable without subjecting them to frequent planing and varnishing. He slips over the desk tops a pressed-cardboard cover, which he calls an envelope. The envelopes are made to conform with the general shape of the desk tops, and the outer edges are bent down and back and riveted, so that the cover will slip on over the desk top and will remain in position after it has been adjusted.

There is a groove indented at the top of the cover to receive pencils and pens, and a circular opening is provided through which the inkwell shows.



The cardboard cover keeps the school desks always presentable

The More Fruit You Eat the Less Water You Need Drink

MOST fruits contain from 75 to 95 per cent water, and a balance of woody fiber, or cellulose, fruit sugar and minerals. Thus the free use of fruit daily, insures a greater supply of water to the body.

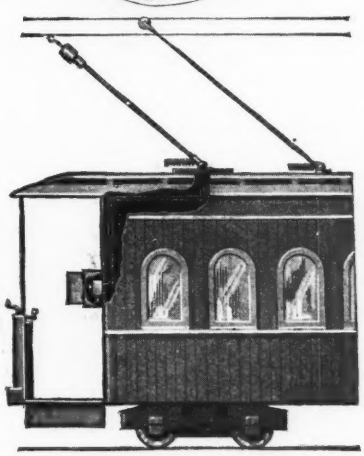
The cellulose of the fruit supplies bulk and a mechanical stimulation which promotes waste elimination. Acid fruits, such as oranges, lemons, limes, and most berries, contain a certain chemical compound called "vitamines," in a very stable form. These vitamines are believed to purify the blood and to prevent scurvy and various skin diseases.

Do Your Telephoning While Riding On a Trolley-Car

WHAT an advantage to be able to telephone from a moving train! Suppose you want to warn your wife that you are bringing a friend home to dinner. How easy, if you could take down a receiver in the trolley-car and break the news to her while you are yet afar off. Or, maybe you are a detective and have spotted a long-sought criminal. A telephone would enable you to communicate with headquarters at once.

At any rate, L. Zsitovszky of Philadelphia, has shown that this can be done by inventing an apparatus attachable to an ordinary trolley-car. In addition to the regular feed wire above are two other parallel wires for the transmission of messages. Contact is effected by small trolleys similar to the large trolley. The two wheels are mounted on arms connecting with a split collar, attached to the end of a metal pole on the top of the car.

The wires pass down through the pole and enter the telephone instruments in the ordinary way. They are arranged below the feed wire as a means of protection.



The train-telephone. The telephone wire is arranged below the trolley feed wire

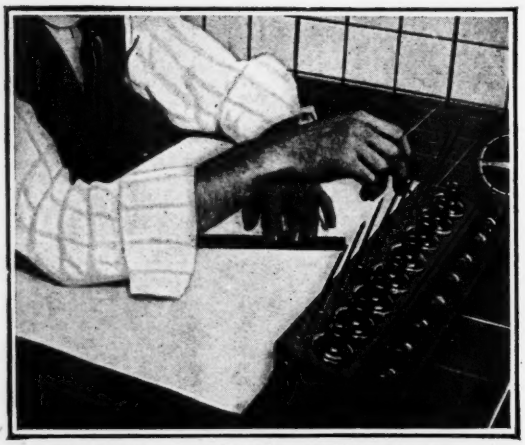
The lock fits over the porcelain terminal that extends from the magneto case

A Lock Which Makes the Ford Car Thief Proof

POLICE statistics show that thieves are constantly stealing Fords. There are plenty to select from and they are easy to dispose of. The lock illustrated bids fair to reduce to a marked extent the get-aways. It shuts off the ignition at its source.

The design and location of the Ford magneto lends itself readily to the positioning of the device. The lower end of the cartridge fits over the porcelain terminal that extends from the magneto case, while the top of the lock extends through a hole in the floor of the car which places the device conveniently under the coil box on the dash.

By pressing the small lever down with the foot, the engine is shut off and the ignition system locked. A special serial key is required to unlock and place the system in operation. When locked it is impossible to make a new connection with the magneto, since forcing the lock from its support will destroy the connections and render the magneto inactive.



The bottles contain inks of different colors. Each pen acts as a guard for its bottle

Using a Dozen Different Inks Without Making a Mistake

MECHANICAL draftsmen, architects and map makers often use as many as ten inks of different colors in making a complicated drawing. Sometimes it happens that the engrossed artist thrusts his pen into the wrong bottle of ink and draws a blue instead of a red line. Then follows an effort to erase the wrong line, with consequent loss of time.

Frank B. Gilbreth, the well-known efficiency engineer, overcomes this difficulty very simply and effectively. He has devised a special stand to hold both the ink bottles and their pens. As the accompanying photograph shows, each pen is thrust vertically into a hole directly in front of its bottle. The pens thus constitute a barrier in front of the bottles.

When a green line is to be drawn, the draftsman picks up the proper pen and thus clears the way for the green-ink bottle; only that bottle and no other can be reached. It is impossible to thrust the pen into the red-ink bottle, because that is guarded by its pen.

Don't Drench a Plant: Water It Drop by Drop

LUCIEN DANIEL, a French botanist, has discovered that young hothouse plants and slips of vegetables, as well as flowers, thrive far better by a system of continuous watering than by drenching the soil at stated periods. The new method depends upon the law of capillary attraction. Near each plant is placed a jar containing water, into which is dipped one end of a strip of linen or cotton, whose other end lies near the plant. With this uninterrupted supply of water, drop by drop, the plants thrived, greatly outdistancing other plants, which were submitted to an intermittent drenching.

The Sailors and Marines Sleep On Their Life-Preservers

IT MUST afford considerable consolation to the Navy recruit to realize that the mattress on which he sleeps so comfortably at night will stand him in good stead in case of an accident to the ship. In fact the very buoyancy which makes it such a comfortable bed is also the quality which makes it possible for it to be converted at a moment's notice into a life-preserver.

The mattresses are stuffed with kapok, a lighter-than-cork material which is imported from the West Indies in bales similar to bales of cotton. It is made from the seeds and silk of a tree not unlike the cotton-wood tree, but instead of being in puffy balls, the kapok is in slender threads, which when compressed make a mass that is six times more buoyant than cork.

Thin layers of the kapok are enclosed in strong ticking for the mattresses. Each mattress is provided with tapes long enough to tie around the body and over the shoulders, as shown in the illustration. It requires only a minute to adjust them.

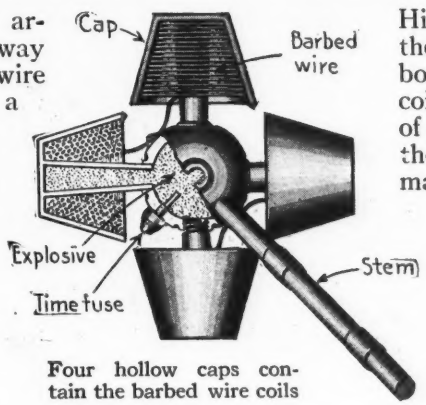
Recruits at the Newport Training Station in their life-preserver mattresses

Hurling Barbed Wire at the Enemy

A projectile is used from which barbed wire is uncoiled after it is shot at the onrushing troops

When the projectile explodes, the caps containing the barbed wire shoot out like bullets in all directions distributing the wire in great tangled masses

AFTER a murderous artillery fire has swept away the ordinary barbed wire entanglements in front of a trench, there is nothing to impede the onrush of troops except machine-gun and infantry fire, accompanied, at certain times, by well-placed barrage fire from the rear. Under most conditions this resistance is sufficient to deplete the ranks of an invading force but the fact that the first, second and third line of trenches may be captured in a single charge is proof that gun fire alone cannot dissipate a body of troops. There have been numerous occasions in this war where troops of both sides have deliberately plunged through a heavy barrage fire to carry a line of trenches.

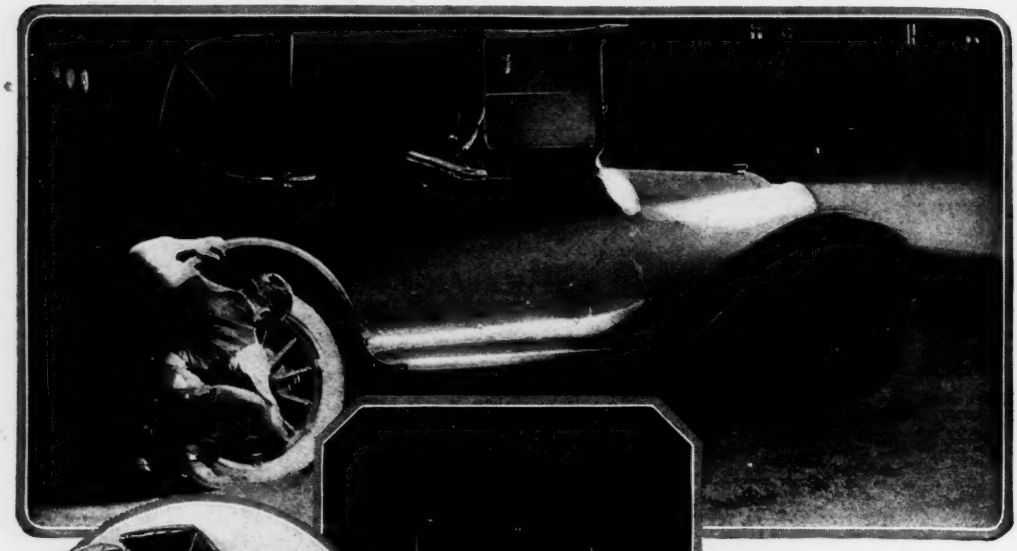


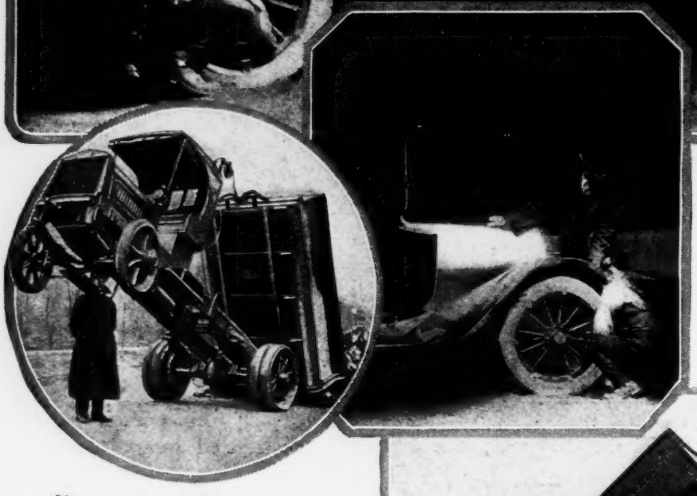
Four hollow caps contain the barbed wire coils

Accordingly, Enid S. Wales, of Detroit, Michigan, has invented a novel projectile which shoots barbed wire instead of bullets. His idea is to first impede the progress of an onrushing body of troops by spreading coils of barbed wire in front of them and then to attack them with infantry and machine-gun fire. The inventor claims that his projectile will distribute masses of barbed wire over a large area, enmeshing a whole company of troops.

Briefly, the projectile consists of a stem which fits the barrel of a trench mortar; a central chamber containing the explosive charge, into which chamber the stem fits; and several hollow caps which carry the coils of barbed wire, the inner ends of which are secured to the body of the shell. When the projectile explodes, the caps containing the barbed wire shoot out like bullets, distributing the wire in tangled masses. A time fuse is provided so that the distance can be gaged.

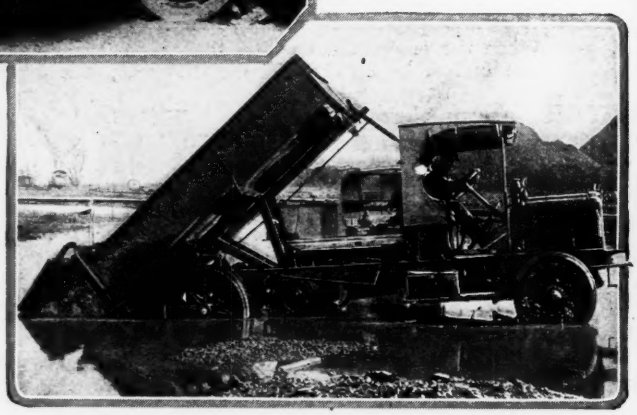
Feats That an Automobile Can Perform and



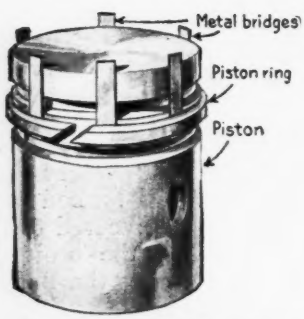


The pivoted headlight is a welcome innovation in shooting trouble at night. The intense, direct rays will light up the rear, and the reflected rays the front of your automobile

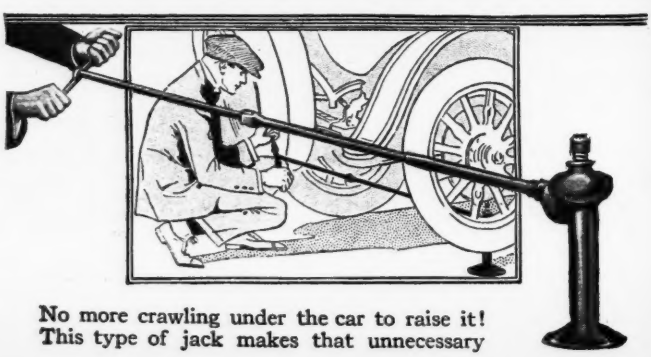
The automobile as an acrobat. This "stunt" was pulled off when the heavily loaded truck slid back but didn't dump. Once the front of the chassis was started upward, it turned around on its ball-bearing pivot



Talk about the mud the war-tanks go through! This truck wades hub-deep across a swamp in filling it up



In replacing a piston-ring, bridges of tin will enable you to pass the groove

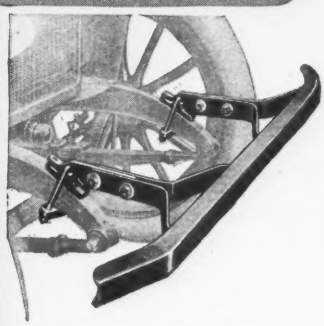


No more crawling under the car to raise it! This type of jack makes that unnecessary

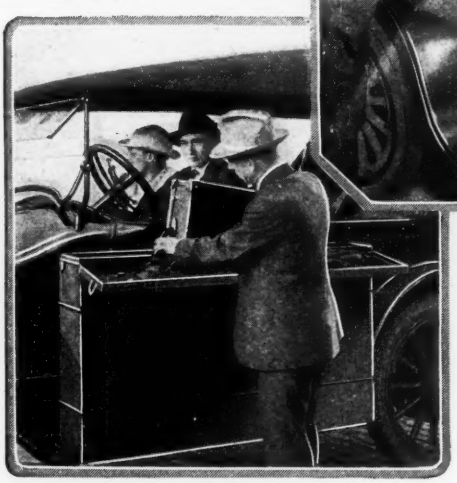
New Additions to the List of Accessories

Four-wheeled drive enables truck and trailer to get sufficient traction even on plowed ground. Its use in carrying products direct from the farm is important in war

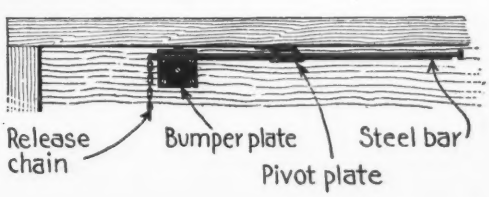
The little flashlight has nothing on this method of lighting your engine. When the pivoted-searchlight principle is applied to your spotlight, it is easy to locate trouble

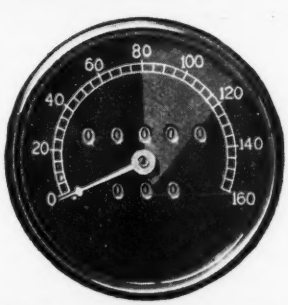


This bumper will not only protect the car, but will cushion a blow as well. The two flat, Y-shaped springs permit a three-inch yield in case of a collision. Bent bumpers will become less common

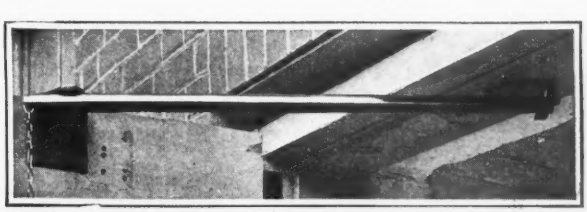


A neat and convenient valise and wrap-case to carry on your next automobile trip





Four differently colored pie-like sections make your speedometer-dial easy to read



Your automobile will not be scratched if the garage door is locked by this simple holder

"You Made Me What I Am Today"

There are numbers of patents that have made money and lost more in the automobile game, not counting all the accessories for ruining a man's pocketbook, such as spotlights, roller curtains, mud scrapers, dust suckers, tack pullers and perfume bottles. The Tillinghast patents covered single-tube tires, and Theodore Dodge made money before that tire blew out; Dunlop made money; the Grant patent for solid tires reaped a fortune and Harry F. Baker is riding in ease on Kardo patents for ball bearings. But it is William Barber of Brooklyn who smiles at us above, over his valve cages used by valve-in-head cars and motorcycles. Great automobile companies pay him royalties

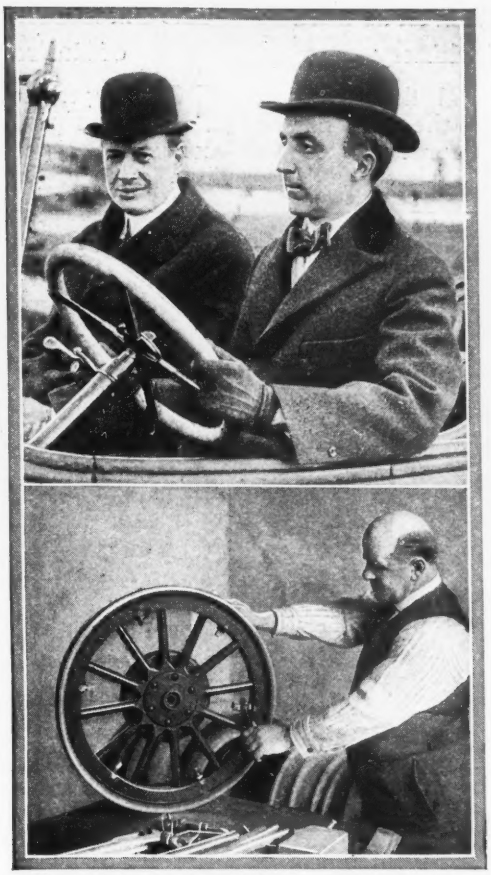
Since all great men are linked with their enemies, George B. Selden ought not to object to our mention of him in the same breath with Henry Ford. Back in 1879, Selden quietly took out a basic patent on the modern automobile. The document dealt with a gas engine, using a clutch and transmission to drive the wheels of a vehicle, and it caused more battles than the Indians ever fought. The first great cases were won by Selden. Ford with the aid of Briscoe won the second batch. The patents were eventually declared invalid. Over eighty manufacturers paid a total of $2,000,000 in royalties under the Selden patents. Look in any old magazine and see their names in advertisements

You will look a long way through Who's Who in America without finding these names, but it is an oversight that Leonard Huntress Dyer is not in there. Most of these lights of the automobile game were just crazy inventors —according to their neighbors— but Dyer is a well-known lawyer of Chicago and New York. The papers in his case—we ought to call them limousine papers because they all led to closed car opulence—had to do with a series of gears which employed a direct drive in one line with the clutch engine and driving wheels. Fortunately Dyer knew something about the courts. So he fought only a short distance down the ages and then sold the rights to an association of manufacturers of automobiles

Oscar Hedstrom, who is older now than when he posed for the picture at left, showing him with his first motorcycle, was a bicycle rider in the old days before gasoline did the work. He risked his neck before Glen Curtiss made his famous speed record in Florida. He wanted a way to pace a rider without wearing out the legs of two or three men; so he put a gas engine on the bicycle and patented the idea. He has never recovered since, because the royalties have been coming in a golden stream and because he came to be regarded as such a valuable motorcycle engineer that he was given a contract with one of the biggest of the manufacturers in the business

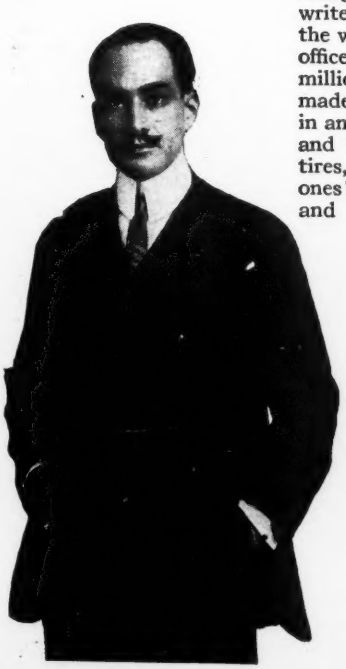
They Sing of the Automobile and Motor-Truck

Seeing him sitting here at the right so peacefully, you would not picture Ray Harroun in goggles on a Vanderbilt racer; but that was where he got his start. There was nothing in the world so natural to a racing driver as something to smooth bumps and to act as a cushion when you hit a competitor going only a hundred miles an hour when you are doing a hundred and twenty. The idea came to him when he was fiddling with two little steel springs and watching them interacting on each other. It's a bumper that lifted him from the realms of the circular track to an office desk at so many thousands per week that we blush to speak of it



Mosler (below) went into partnership with an inventor from Manistee, Michigan, before he had much use for the initials A. R., which he now always uses. The patent (the Canfield patent) concerned a spark plug with an air-gap between the insulation and the insulating shell. The fortunate inventor died happy leaving his partner with a duty and a fortune looming before him as his particular Nirvana. And how Mosler did fight! The case dragged for years, as is our happy American custom, but Mosler won. Have you wondered who all those limousine owners in New York city are—those men who go to work at three in the afternoon and quit at three-thirty? They are A. R. Mosler, his sons, uncles, nephews and other relatives

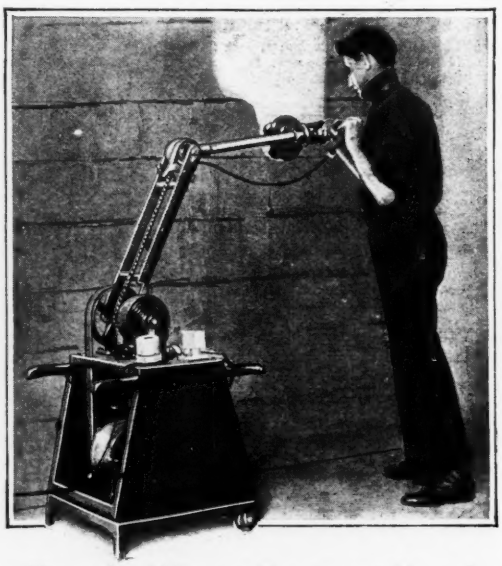
The story of L. H. Perlman and his demountable rims (regular equipment—no extra charge) would be meat for a short-story writer. The picture shows him looking over the wheel that rolled him through the patent office and the courts; but the check for three million dollars which was the first payment made the Perlman Rim Corporation is framed in another room. Perlman was first a printer and then a tinkerer with automobiles and tires, and he did hate to put on new ones! He put together a wedge and a screw and secured patents on the combination



At left: You see this man's work (Edward Hartford) on the back of every high priced car and even on the front. His papers—the same ones which put him on this page—are his because he applied the shock-absorber to the automobile and made even delicate débutantes willing to ride in broughams. He proceeded with caution by first buying the Truffault patents which had to do with bicycles and then applying them to the automobile, and then taking out more patents. But even then he had to fight his way through the courts to establish his claims. You see by the picture that he can afford a nice watch chain

Scrub Your Walls as Well as Your Floors by Machinery

WITH the mechanical floor-scrubber already added to the long list of newly-contrived devices for insuring absolute cleanliness and saving the back and disposition of the modern housekeeper, it is only natural that the next addition should be the mechanical wall-rubber. Let it not be imagined, however, that the wall-rubber is for use only in the home. Unlike the floor-scrubber, it can be used wherever there is need of polishing. Adapted for cleaning sunken panels, bands, spots, slabs and walls of marble, granite and tile, it can be used in the home, in the office building, in the cemetery and in the subway with equal facility and good results.



The wall-rubbing machine is portable and is operated from any electric-light socket

The machine is portable. It is driven by an electric motor which receives its power from an electric-light socket. The jointed arm to which the polisher is attached has a vertical reach of six and one half feet from the floor and a horizontal reach of eight feet. Two spiral springs counteract the weight of the arm, so that the operator has only to guide the polisher over the surface to be cleaned.

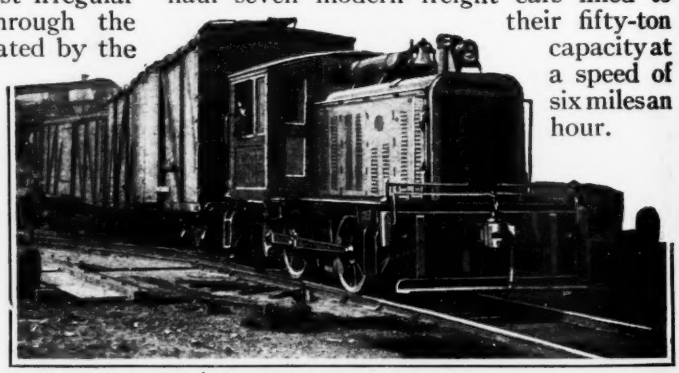
A compensating shaft attached to the polisher keeps it pressed against irregular surfaces. Water is forced through the polisher by a small pump operated by the motor. A reservoir in the cabinet part of the machine holds the water. It is supplied to the brush in a constant stream, which may be regulated so that only a small amount, enough to merely moisten the brush, or a copious flood for rinsing large areas at a time, may be obtained. No effort on the part of the operator is required except to guide the rubber.

The Gasoline Automobile in the Role of Railroad Locomotive

FOR long trunk lines, the steam locomotive has proven itself to be the most economical type of tractor. For short lines, and for factory yards or railroad terminals, however, steam propulsion is about the most expensive. Whether the locomotive is standing idle or not, steam must be kept up, and coal must be used continuously. The gasoline locomotive which has now entered the field is doing all that the steam locomotive does, without the former's waste when inactive.

This gasoline locomotive is virtually the ordinary automobile mounted on a locomotive frame. The six cylinders of the huge gasoline engine furnish one hundred and sixty horsepower. Connecting the engine shaft with the wheel driving-cranks on either side of the locomotive are a rigid gear transmission and an automobile friction clutch of appropriate dimensions. The side-bars connecting the wheels with the cranks are exactly similar to those on the regular steam locomotive.

When the gasoline, which is stored on the top of the hood, is fed into the engine under full load conditions, the locomotive can haul seven modern freight cars filled to their fifty-ton capacity at a speed of six miles an hour.



This locomotive, hauling seven cars, is driven by a six-cylinder gasoline engine giving one hundred and sixty horsepower

What a Match Is to Your Cigar

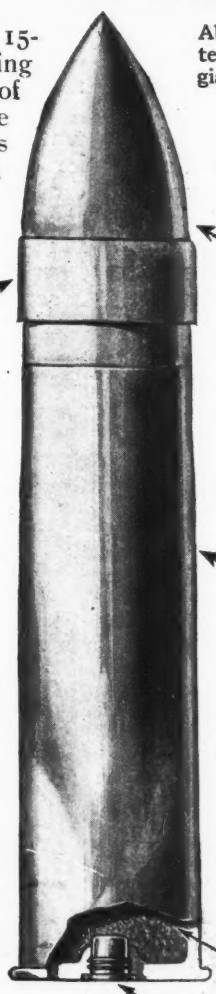
So is a primer to its giant shell

Above: Crater made by giant shell

NOWADAYS every one knows what a shell looks like, and some of us can even differentiate between a high-explosive shell and a shrapnel. We are quite familiar with shells of small caliber and read constantly of the destructiveness of the large 15-inch and 16-inch shells. There is nothing novel to us in the general appearance of a shell such as shown here. We know that in the base of that shell is a little disk which corresponds with the cap in the cartridge-case of our own shot-gun. This is the primer, and while its existence is taken for granted, its mechanism and operation are less widely understood.

It is the primer which ignites the charge in the cartridge case to drive the projectile from the gun on its mission of destruction. Its function is similar to that of the cap in the base of a shot-gun cartridge, but the duties devolving upon the primer of an artillery shell are more complex. The primer has not only to fire the powder charge in the cartridge case, but also to prevent any of the propelling gases from escaping back into the breech of the gun.

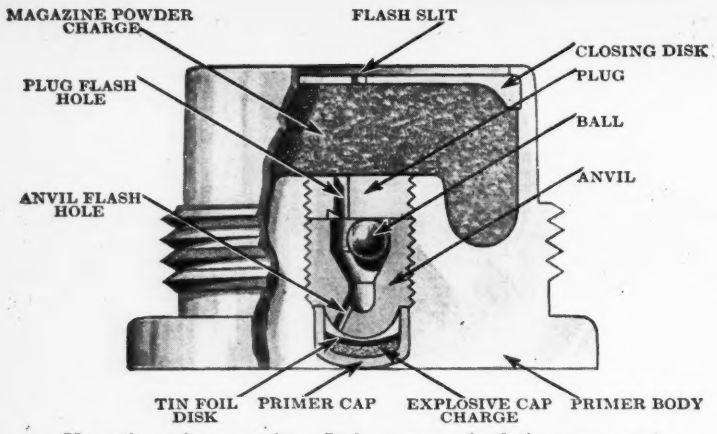
The primer is composed of six parts—not including the explosives used—each one of which has a distinct and definite duty to perform. First, there is the primer body, which houses the operating mechanism and mediums and which screws into the base of the cartridge case. In what may be termed the primer "hub," there is the primer cap which corresponds with the cap of a shot-gun cartridge. Next comes the anvil against which the explosive cap has to be driven to ignite the charge. Capping the central hole of the hub and holding the anvil in place is a tight-fitting plug with several flash holes. Completing the primer is the closing-in disk over which the edges of the primer body are riveted. Within the conical cavity in the anvil base is a small soft brass ball which plays an important and interesting part.



The primer ignites the charge in the cartridge case to drive the projectile from the gun on its deadly mission

A highly explosive and ignitable substance is contained in the primer cap and held in place by a tin-foil disk. This explosive substance is readily set off by shock and is driven against the anvil block by the hammer of the gun on firing. The flash created passes through the anvil by way of small flash holes leading through the anvil nose to the cavity in which the soft brass ball is loosely confined, then through the flash holes in the plug, destroying the paper disk cemented to the top of the plug to prevent the powder in the magazine of the primer from working down through the flash holes. On the under side of the closing-in disk is another disk of paper to prevent the escape of the magazine powder charge through its flash slits. The flash transmitted through the anvil and plug from the explosion of the primer cap ignites the powder in the magazine, which, in turn, ignites the propelling charge in the cartridge case proper. The flame from the primer magazine breaks through this second paper disk and escapes through the radiating flash-slits in the closing-in disk.

The explosion of the charge in



How the primer works. It is composed of six parts, each of which has a very distinct and definite duty to perform

the magazine creates gases, some of which attempt to escape by passing back through the flash holes in the plug, and this is where the soft metal ball previously mentioned comes into action. The gases impinge against this ball, and drive it into the base of the cavity where it acts as a cork, stopping up the passage and effectually preventing the gases from escaping through the base of the primer. This little ball therefore forms an invaluable safeguard both to the gun and the gunner, at the same time insuring the efficiency of the primer.

Such is the operation of the primer. It is an ingenious little mechanism without which the shell would be comparatively harmless and might be thrown about, dropped or otherwise maltreated without danger of explosion. As for the primer itself, it would be no more dangerous, if it were not for the explosive cap in its base, than a shotgun cartridge with its cap removed. In fact, the primer of an artillery shell can be likened to an ordinary blank cartridge.

Although primers are completely assembled in the arsenals or factories in which they are manufactured, they are usually not inserted into the cartridge case until the projectile is being prepared for use—probably behind the lines on the battlefield. The transportation, therefore, of artillery ammunition can be undertaken with little liability of accident through explosion. The active agent controlling the destructiveness of artillery shells, i. e., the primer, constitutes the one dangerous part of the shell, but separate from the cartridge case, the primer, even with its cap fitted, can do little damage. A blow on the charged primer cap is necessary to start things.

Making Highways on the Mud-Pie Principle

SOME enterprising folk in the Imperial Valley desert, near Coachella, California, have discovered an easy and exceptionally inexpensive method of securing public highways without employing other labor than that necessary to flood the highway area with water. In this simple way otherwise impassable desert paths are converted into excellent hard adobe, which makes as fine an automobile road as asphalt.

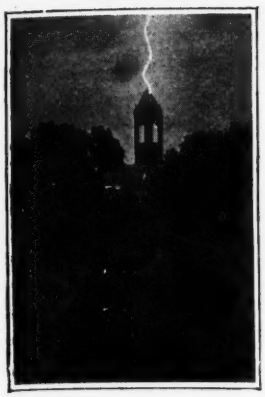
The highway in the accompanying illustration is invisible; it is two to three inches beneath the water. But when the water is drained off and the blistering hot sun bakes the wet ground into one long ribbon of a mud-pie, it does not loosen under the heaviest of traffic. Sluiceways are first constructed through the proposed highway and the irrigation waters from nearby ditches are then turned into them. After the water has soaked into the ground it is shut off; any remaining water is led into the fields and used again. The treatment costs nothing more than the labor necessary to dig the sluiceways.

The success of this method of quick road-construction depends upon the clayey character of the soil.

When the water has been drained off, a hard, sun-baked adobe highway will result

The Ben Franklins of Today

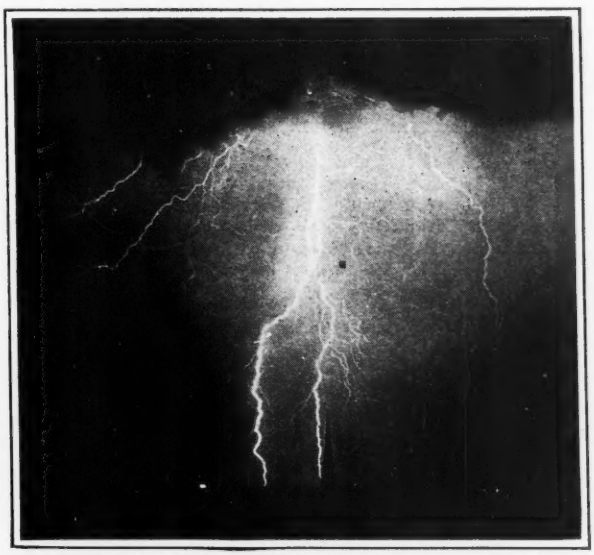
They study lightning with the camera and at last they have told us what it is and by what it is caused



Lightning striking the steeple of the First Presbyterian church of Greensboro, North Carolina

THE recent progress of knowledge concerning lightning has far outstripped the ordinary reference books.

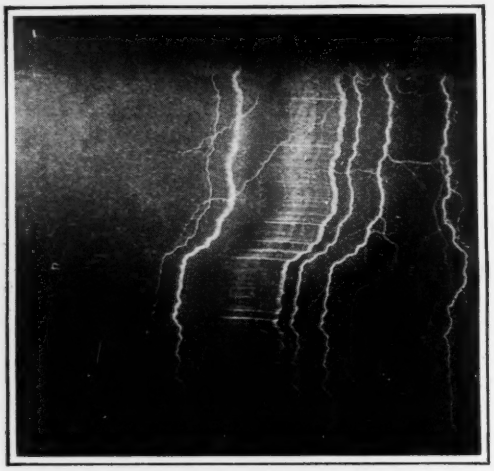
Thanks to Benjamin Franklin and his famous kite, our great-grandfathers knew that lightning is an electrical discharge, and they were also familiar with the lightning-rod. These gentlemen, however, supposed that lightning commonly occurs in zigzags, with sharp angles, and not until photography was applied to the study of the phenomenon (about thirty-five years ago) was this erroneous notion dissipated. Our immediate ancestors—in this country, at least—had likewise learned to view the lightning-rod with considerable suspicion. Early in the nineteenth century thousands of defective rods were erected by ignorant or unscrupulous itinerant "lightning-rod men," whose names have become a by-word among us. These persons, to quote a recent authority, "used all kinds of fantastic and peculiar shaped terminal rods and conductors, the main object apparently being to make as great a show with as little material as possible. Their work is almost entirely confined to the upper portion of the conductor, to the absolute neglect of the most important part—the earth terminal. The majority of the lightning conductors in America are consequently untrustworthy. Unhappily these traveling impostors are by no means extinct, although increased knowledge is gradually driving them out of the field." Besides, the construction of the rod itself has undergone improvement.



The flash seen to the left of the steeple was virtually instantaneous. That at the left of the chimney is a multiple flash, lasting for a fraction of a second

Scientific progress in the study of lightning is due, to a great extent, to photography. Early investigators, such as Arago, Dove and especially O. N. Rood, had reached the conclusion that many lightning flashes are multiple, consisting of several successive discharges along an identical path, and had also formed a rough idea of the time intervals involved. Various forms of rotating disk were used in their experiments. Far more accurate information on this subject is now obtained by the use of a camera mounted on a vertical axis and swung in a wide arc, at a fixed rate, by means of clockwork. This method has been gradually evolved from the crude process of merely holding the camera in one's hands and giving it a side-to-side motion—the method followed by Trouvelot since the year 1888 and by Weber and Hoffert in 1889. The perfection of the moving camera is due, in part, to Larsen, in America, but especially to Dr. B. Walter, of Hamburg, whose achievements in the photography of lightning far surpass those of any other investigator.

Walter began by photographing, with



A novel effect in photographing lightning by holding the camera in the hand and giving it a side-to-side motion

the moving camera, artificial electrical sparks in the laboratory, and showed that such sparks begin with a brush discharge from each of the electrodes, these partial discharges gradually ionizing the air (i. e., making it a conductor of electricity by breaking up its molecules into positive and negative "ions" or electrified particles), between the electrodes, until finally the whole interval is bridged over by the spark. Something similar appears to occur in a lightning flash.

Growth of electric spark discharge, illustrating the way in which the lightning flash builds up its path through the air

It is obvious that if a discharge of lightning has a sensible duration, the rotary movement of the camera will spread out the flash, as impressed on the plate, into a more or less broad ribbon. Most photographs of ribbonlike streaks of lightning are, in fact, due to the accidental movement of the camera during exposure. When the camera is held in the hands, the occurrence of a flash commonly causes the photographer to give an involuntary start, and this explains not only cases of ribbon lightning, but also various other peculiarities of ordinary lightning photographs. A certain amount of spreading in the flash is, however, due in some cases to "halation."

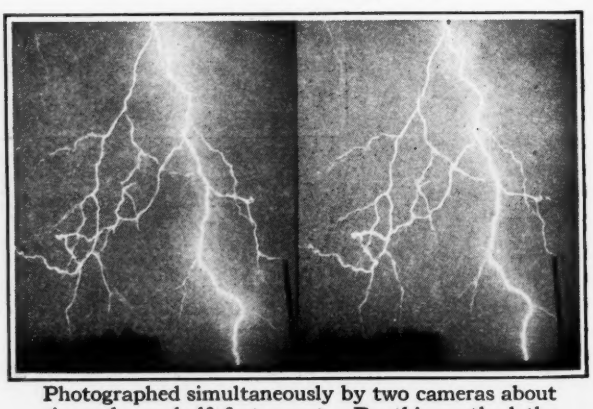
The splendid photographs of Walter with a camera rotating at a known rate enable us to make an accurate time analysis of the details of the flash.

How Long Does a Flash of Lightning Last?

Such photographs show that some flashes are practically instantaneous, while others may last as long as half a second or more. When flashes of the latter class are photographed by Walter's method, the resulting picture shows several parallel streams of light, proving that a number of successive discharges occurred along the same path. These give to lightning its flickering appearance.

A photograph of this type taken by Larsen shows forty distinct discharges in a single flash, at average intervals of 0.0156 seconds, the total duration of the flash being 0.624 seconds. Photographs of this character also frequently show the preliminary partial discharges.

Walter improved the moving camera by the addition of a stationary camera with which exposures are made at the same time, in order to show the actual direction of the flash from the observer. The same investigator has more recently developed a stereoscopic process of photographing lightning. Two stationary cameras are set up side by side, several feet apart, and pointed in the same direction. When a flash is photographed, its position on the two plates is different with respect

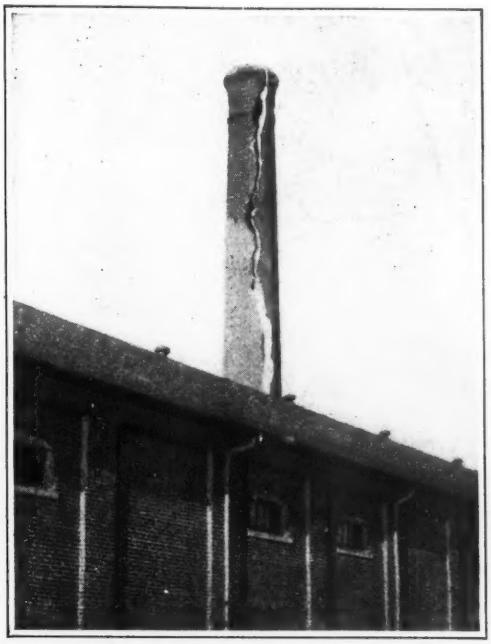


Photographed simultaneously by two cameras about six and one half feet apart. By this method the actual distance of the lightning can be determined

to objects in the foreground, such as trees, buildings, etc., and, the distance of these objects from the cameras being known, the distance of the flash can be determined.

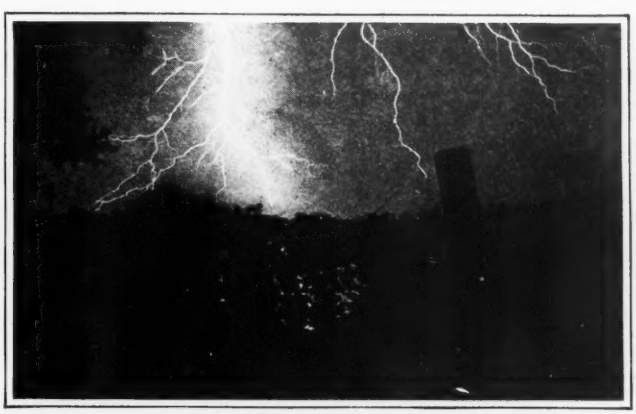
Lightning Sometimes Shifts to One Side

The ionized path of a multiple flash is not always stationary, but is sometimes shifted a considerable distance by the wind. In the case of a photograph taken by Rümcker with a stationary camera, when the place where the lightning struck—and hence the distance of the flash from the observer—was accurately known, the flash shifted laterally a distance of thirty-six feet during visibility. This phenomenon appears to explain certain cases in which well-installed lightning-rods are ineffective. The initial discharge probably takes to the rod and is carried off harmlessly, but the discharges following keep to the ionized path as it is swept aside by the wind and strike a projecting corner of the building or a neighboring tree. Thus we have what appear to be "divided strokes;" but these are really successive strokes in different places at very small intervals of time.



A brick stack cut in two by a stroke of lightning during a thunder storm

Several attempts have been made to estimate the strength of current in a stroke of lightning. Pockels, in Germany, adopted the ingenious method of measuring the residual magnetism in a mass of basalt rock near a place where lightning had struck and comparing these quantities with those similarly obtained in the laboratory. From the strength of the magnetic field produced in the rock by the lightning, he estimated the maximum strength of current in the latter to amount, in some cases, to as much as 20,000 amperes. Humphreys, in this country, has recently examined a hollow copper lightning-rod, crushed by lightning (shown in the photograph on page 368), and has estimated that the strength of current necessary to produce such an effect may have been as great as 90,000 amperes. Both estimates are very rough, since they depend upon assumptions that cannot be verified, but they prove beyond a doubt that the currents in lightning flashes must be reckoned in thousands of amperes. Steinmetz estimated from the intensity of illumination due to a lightning stroke that the amount of energy involved was of the order of 10,000 kilowatt seconds, or 13,400 horsepower seconds. If we assume the duration of the flash to have have been .01 seconds, this would represent a delivery of energy at the rate of 1,340,000 horsepower. But all this is little better than guesswork.



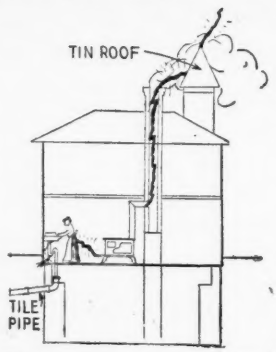
A good example of what is commonly designated as forked lightning, photographed with a hand camera

What Causes Lightning?

The origin of thunderstorm electricity, after having been the subject of endless discussion for generations, appears to have been satisfac-

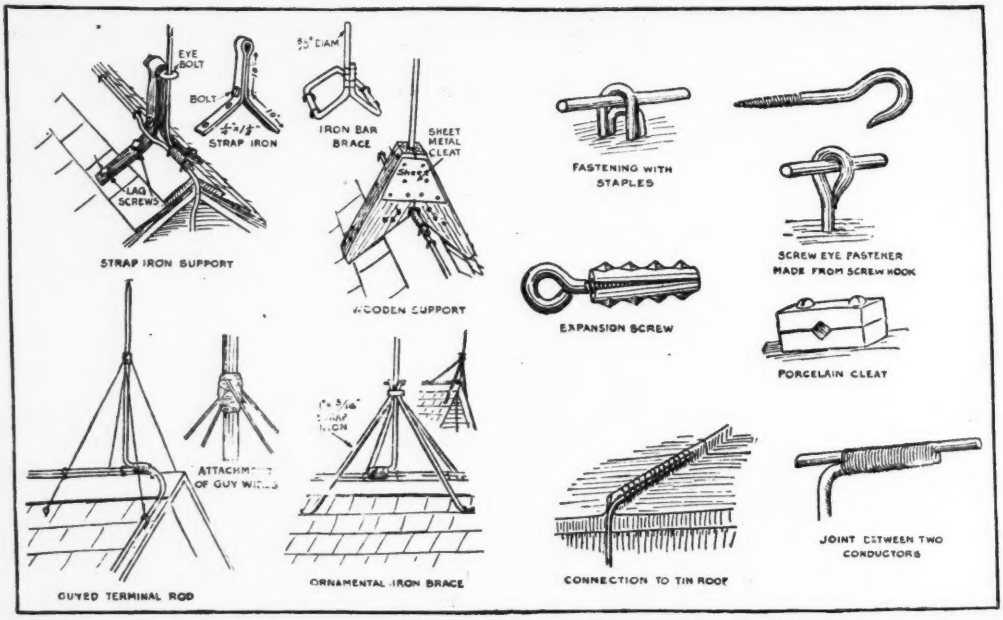
torily explained about seven years ago by Dr. George Simpson, of the Indian Meteorological Service. The first stage in the production of a thunderstorm is a violent and turbulent uprush of air, resulting in rapid condensation of moisture in the form of the immense clouds that characterize such a storm. The drops of water constituting these clouds are repeatedly broken up by the air currents, and it has been proved by laboratory experiments that this process involves the separation of positive from negative electricity. The drops become positively charged; i. e., they retain a greater number of positive than of negative ions. The latter are set free and carried aloft to the upper part of the cloud, giving it a strong negative charge; while the positive ions are carried down with rain. If the process continues long enough, a strong potential gradient is set up between cloud and earth, until ultimately the tension is relieved by an electrical discharge.

A house equipped with properly grounded lightning rods is practically safe from lightning



How a woman was killed when a bolt struck the tin roof of an unprotected house

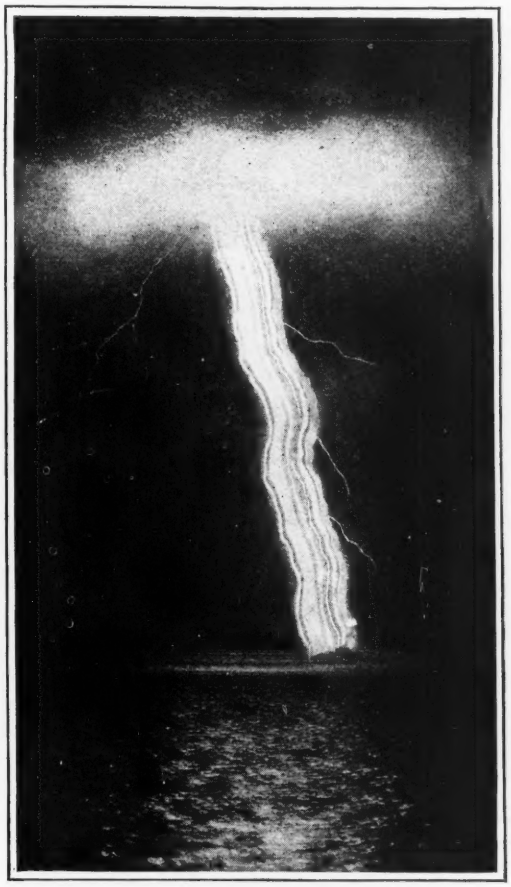
Lightning occurs in many forms and presents many curious features, not all of which are fully understood. Besides the ordinary linear flashes, we have the familiar phenomenon of "sheet lightning," which is, as a rule, merely the reflection on the clouds of distant linear lightning, but may sometimes be an actual diffuse discharge. Dr. Walter Knoche, director of the meteorological service of Chile, has recently described a remarkable form of sheet lightning that occurs on a vast scale along the crest of the Andes during the warm season. The mountains seem to act as gigantic lightning-rods, giving rise to more or less continuous diffuse discharges between themselves and the clouds, with occasional outbursts simulating the beams of a vast searchlight. These displays



The modern method of fastening lightning rods to buildings. Insulators in clamps are no longer considered necessary except in localities where prejudice in their favor still remains

are visible far out at sea. Dr. Knoche once saw them from a distance of three hundred miles. Something akin to "Andes lightning" has occasionally been reported from other mountainous regions of the world.

"Ball" lightning takes the form of a fiery mass (not always globular), which generally moves quite deliberately through the air or along the ground, and in many cases disappears with a violent detonation. Many ingenious explanations of this strange phenomenon have been offered, but none of them is wholly satisfactory. An immense amount of statistical and descriptive information concerning ball lightning has been gathered in recent years; notably by Dr. Ignazio Galli, in Italy.

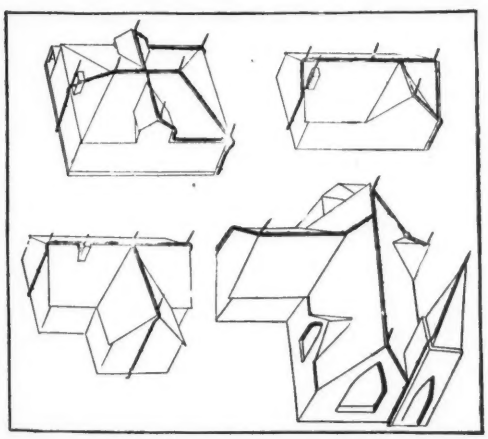


A discharge of lightning of some duration, which is photographed as a broad ribbon of fire

Do Lightning-Rods Help?

Turning, now, to the subject of lightning-rods, it may be stated emphatically that the reputation of these devices has been fully rehabilitated in this country. The Weather Bureau has always strongly advocated their use, and Prof. J. Warren Smith, of that Bureau, has recently assembled some impressive statistics in their favor, compiled from the records of fire insurance companies.

Damage by lightning is comparatively rare in towns, where metal roofs, steel frames of buildings, tall chimneys and other objects constitute an assemblage of conductors capable of dissipating the electrical charge of passing clouds without disruptive discharges between the clouds and the earth. On the other hand, lightning is a thing to be reckoned with in the rural districts. It is estimated that the total property loss from this cause averages $8,000,000 a year in this country; also that about 1,500 persons are struck by lightning in the same period. Nine-tenths of these accidents occur in rural localities.



The correct location and distribution of lightning rods on various kinds of buildings

At present, according to an estimate of the Bureau of Standards, not more than fifteen to twenty per cent of the buildings in the United States which are liable to damage by lightning are protected in any manner against it. Yet, to quote from the same authority, "such evidence as is available on the effectiveness of lightning-rods indicates that, taking rods as they come in the general run of installations, they reduce the fire hazard from lightning by eighty to ninety per cent in the case of houses, and by as much as ninety-nine per cent in the case of barns."

In Technologic Paper No 56 the whole question of protection against lightning is

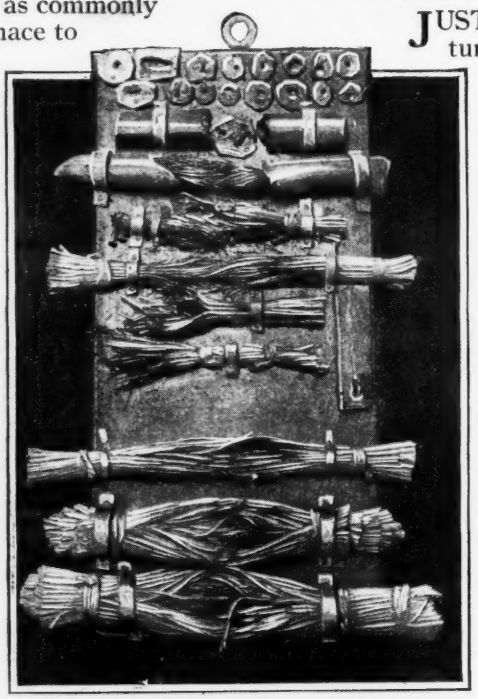
fully treated. *A few salient facts from this bulletin can be quoted appropriately here:

A defective rod is not, as commonly stated, necessarily a menace to a building. A poor rod is generally better than none.

Copper, aluminum and iron are all suitable material for lightning-rods. Iron must be galvanized.

Contact between different metals should, in general, be avoided, to prevent the danger of electrolytic corrosion. Contact between lead and copper is an exception.

Insulators in clamps fastening lightning-rods to buildings are no longer used, except in localities where prejudice in their favor still demands that their use be continued.



A hollow copper lightning rod, crushed by a current estimated at twenty thousand amperes

No system of protection for oil tanks has been devised which is accepted by oil companies as giving a degree of protection at all commensurate with the cost.

The loss of live stock in fields can be reduced by earthing wire fences by means of galvanized iron pipe or posts at intervals of one hundred yards or so, and breaking up the electrical continuity of the fence at intervals by inserting sections of non-conducting wood.

Several ranchmen in the West and Northwest have adopted this method.

It might be well to add in this connection and just at this time when powder magazines and ammunition factories are such an important factor in the world's affairs, that the system of protection from damage by lightning for such places is at present far from satisfactory.

A half-inch groove gouged in a monument by a bolt of lightning

* "Protection of Life and Property Against Lightning," by O. S. Peters, Washington, 1915. For sale by the Superintendent of Documents, Washington, D. C. Price, 35 cents.

Shooting Snapping Turtles with an Ordinary Rifle

JUST before a snapping-turtle makes up his berth preparatory to snoozing away a long winter, he makes a sort of itinerary of small lakes and ponds, apparently with the one purpose of stealing ducks and other water-fowl that live in game preserves. In this way, such ponds often become thickly tenanted with unwelcome inhabitants which are not easy to get rid of. The best plan is to keep the turtles out by means of a fence of coarse wire netting. If this precaution has not been observed and the pond becomes infested, the quickest way to exterminate the intruders is to shoot them with a good rifle.

Turtles are hard of hearing. You can fire a rifle six times in their immediate vicinity without scaring them away. But their keen sense of sight more than makes up for any deficiency in hearing. They disappear in the water the moment they discover anything unusual.

Snapping turtles appear to be very inquisitive. This weakness can be used to advantage. Choose a convenient spot where you can remain motionless for some time and watch your chance to fire the fatal shot. The foolish turtle will be sure to see something of interest and set out to investigate. He may swim a long distance, coming to the surface every few yards to inspect the object of his curiosity. When he is sufficiently near, take careful aim and fire. If your patience is as great as the curiosity of the turtles you will eventually rid the pond of them.

Target Practice with the Smaller Coast Defence Guns

WHEN practicing with the smaller land defence guns, the United States army often uses a self-propelling target which is improvised by the handy men about the fort. The target is carried far out to sea by a launch; there it is set going at a speed of from eight to ten miles an hour, and the guns begin their maltreating of it in true American fashion!

While these targets are the simplest sort of craft, they afford about the best type of target known. Two pontoons fourteen feet long and which stick only a few inches above the water, carry a marking flag.

Usually, both pontoons are armored with quarter-inch boiler-plate, which is covered with gray target cloth. One of the pontoons carries the small motor-boat engine. By means of its rudders, the craft can be made to maneuver straight ahead or in a circle. A buoy and cable are attached to the motor so that it can be recovered from the bottom of the harbor should the pontoon sink.

The self-propelling target. Though the pontoons are almost invisible, the gunners riddle them

The Biggest Red Cross Flag Ever—A New York Creation

This Red Cross flag that adorns a New York city department store measures 100x75 feet

ONE of the big New York city department stores has set the pace in Red Cross flags. Across the Fifth Avenue side of the store is a flag seventy-five by one hundred feet; the hundreds of thousands who daily go up and down the street never fail to marvel at it. The flag was made in the store. It is ten feet larger than an American flag which formerly occupied the position it now holds.

Note the congested traffic in the street. Fifth Avenue is rapidly becoming the most congested thoroughfare in the world despite its width. Traffic moves five blocks at a time and there are traffic policemen nearly every block for more than a hundred blocks of its length.

The Complexities Involved in Making Shrapnel

WERE the average layman able to grasp the staggering complexities of chemical and mechanical details involved in the making of a shrapnel shell he would be amazed. For instance, one hundred and seventy gages are required to manufacture the combination time and percussion fuse for three quarter-inch shrapnel. The powder used must have the correct burning time or the explosion will occur too soon or too late. It is impossible to obtain two powders with the same burning time, hence the burning time has to be determined on each lot of powder. This formerly required one and one-half hours; now it takes five minutes. Likewise, the time consumed in blending powders has been reduced from sixteen hours to fifteen minutes.

Here's the Air-Propelled Unicycle

Some mechanical misgivings about a fantastic invention

DO you remember the old "Star" bicycle? If not, ask your father. He will tell you that it had a little wheel in front, and behind a very large wheel over which you sat. The little wheel in front was supposed to prevent you from taking "headers."

Show your father the accompanying illustrations of A. F. d'Harlingue's air-propelled unicycle and he will say at once: "Why the man has simply put an air-propeller and an engine on a big old Star!"

But the difference between the old "Star" and this curiously ingenious and yet most impractical invention is this: The old "Star" was a simple, operative invention; the air-propelled unicycle is much too complicated to operate successfully.

The POPULAR SCIENCE MONTHLY has not pictured every one of the businesslike gears and elaborate controls which are supposed to adapt this machine for high-speed travel and racing. It's unnecessary to do so. But it has emphasized the two fanciful and fundamental features, namely, the unicycle design intended to result in a vehicle running normally on one wheel only and, secondly, the use of an air-screw for propulsion. The fascination of combining these features may have arisen from the recognized difficulty in applying engine power in a unicycle by ordinary mechanical means, so that the use of an air-screw came to appear as the happy solution of a problem.

Compare this construction with a motorcycle and especially with a pace-making machine having the driver's seat at the extreme rear. With the motorcycle, the practical speed is limited only by the driver's ability to endure the jolts or his willingness to take chances. The wastage in the transmission of the engine is small. The resistance in the wheel spindle-bearings is evidently insignificant compared with that to be looked for in the corresponding bearings of the unicycle, which are those of the three roller disks shown in the engine-carrying frame, subject to constant side pressure from a bevel-pinion drive. The loss of engine power in the transmission of the unicycle is enormous. There are constantly in mesh a large number of elements. At turns, there are, in addition, two hand-operated worm-gears for turning the T-shaft of the air-screw upon its vertical pivot-pin (against a considerable resistance when the screw is going), and this further operates a train of three spur-gears to make the front wheel participate in the turn and—when it is on the ground—help in directing or stopping the big wheel.

The loss of efficiency due to the many transmission gears is small, however, compared with that of the air-screw, which cannot be more than three and one-half feet in diameter so each blade is less than twenty inches long. An air-screw of these dimensions, at the present stage of knowledge, has about one-fifth of the efficiency and one-tenth of the capacity of a screw with forty-inch blades and can scarcely absorb more than fifteen or utilize more than two-horsepowers at the utmost velocity that can be imparted to it through gears. On hills, the machine would be reduced to very low speed with high fuel consumption.

An air-screw even so small as three and one-half feet in diameter would be dangerous to bystanders and wayfarers; a larger and more efficient one would be entirely out of the question on the road.

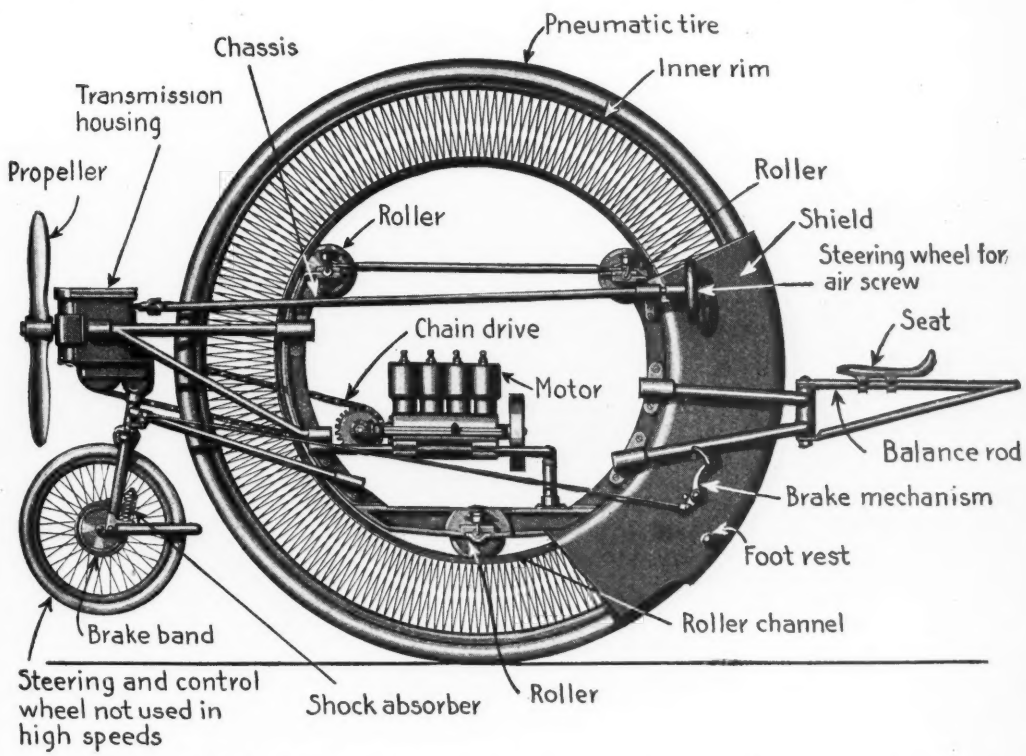
Ordinarily the front wheel, which somewhat spoils the unicycle idea, is supposed to hover in the air when the machine is running, the driver sitting on a sliding seat, balancing his weight against that of the front structure by pushing the seat to the balancing position. The claim is made that by shifting his seat he can make the air-screw inoperative, but nothing is shown to substantiate this assertion. To the front wheel a brake mechanism is secured, to be operated with a long rod, and the inventor believes that this brake

can be operated with safety even on a curve, because the little wheel is then turned into the curve by its geared connection with the air-screw. The safe and sane brake system of the motor-bicycle shines by comparison.

The only worth-while advantage of a unicycle over a bicycle is that it can be steered by simply leaning to one side, but this solitary advantage, exemplified in a boy's play-hoop and largely utilized in the old ordinary and "Star" bicycles, is deliberately abandoned in d'Harlingue's construction. By rods (one of which is shown) and the worm-gears before mentioned, the air-screw is supposed to be swung to the side in order to turn the big wheel. All the complications arising from this misunderstanding of the case are accepted.

What are the supposed dimensions of this unicycle? They are indicated by the distance from the seat to foot-rest, which must be about three feet to fit an average man. That gives the diameter of the big wheel as nine to ten feet and that of the air-screw three and one-half feet, as mentioned before. The chain-drive is about six feet long. The aluminum shield in front of the driver is bent and hammered from a sheet at least six by four feet. Though in this class of vehicles relative proportions are vital, the engine and its dimensions, as shown, must not be taken seriously. By estimating bore and stroke on scale with the rest, they would indicate sixty to eighty horsepower at 1500 revolutions per minute, but then the engine is also shown as watercooled, yet with no provisions for disposing of a radiator or other bothersome detail.

A jolly sport machine might be produced on the basis of d'Harlingue's general idea by radical simplification of his design, including the omission of front wheel and all gears and placing a little high-speed one-cylinder engine directly behind the air-screw. The shaft could be tilted upward a little and the diameter of the big wheel reduced to five or six feet. Braking could be done by drags at the rear under foot or hand control. But an engine starter would be found indispensable.



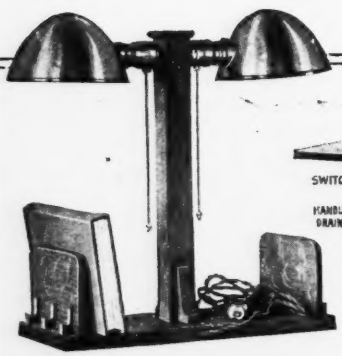
If a unicycle could be driven with a smaller resistance and at greater speed than a bicycle, if it could be built more economically or compactly or could be operated more safely or enjoyably, and if small air-screws could be made to apply a thrust against the atmosphere without a vast loss of power as compared with the mechanical rotation of a driving wheel, the combination might lead to desirable results. Alas! Each of them is inferior, and their combination multiplies their degree of inferiority compared with the motor-bicycle with mechanical transmission

Housekeeping Made Easy

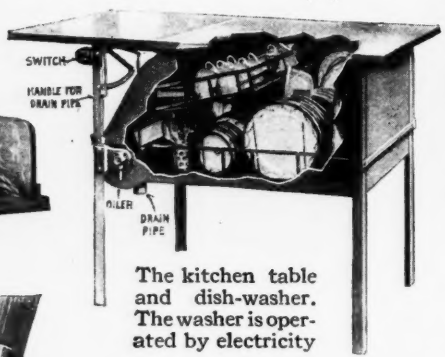
A scientific cooker for meats, poultry, vegetables, fruits and cereals. Above is a sectional view of it. It has three bottoms designed to prevent the utensil from coming into direct contact with the flames and to concentrate and conserve the heat

Coring apples and cutting them into quarters in one operation. You simply press on the handle and give it one quick turn

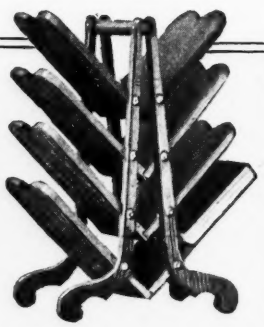
A unique cover for the humidor which is a combination affair on the order of a smoker's kit. It holds pipes and matches and serves as an ash tray when desirable. It fits into the top of the humidor



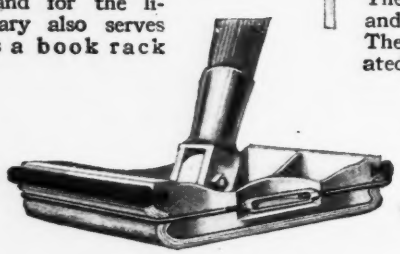
The electric light stand for the library also serves as a book rack



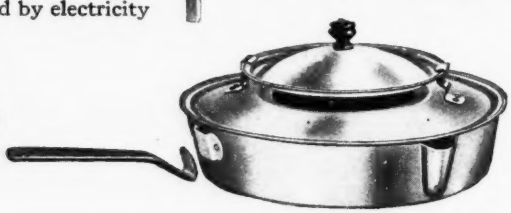
The kitchen table and dish-washer. The washer is operated by electricity



The newest and oddest design in racks for books, magazines and newspapers

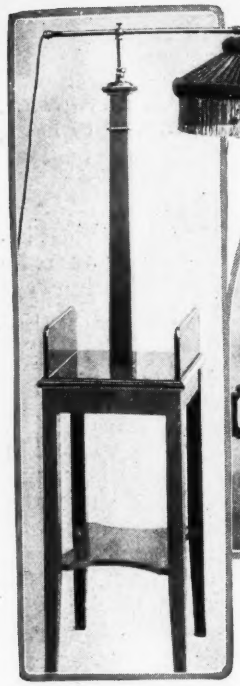


A machine for sanding floors evenly does away with the back-breaking labor involved in sanding by hands

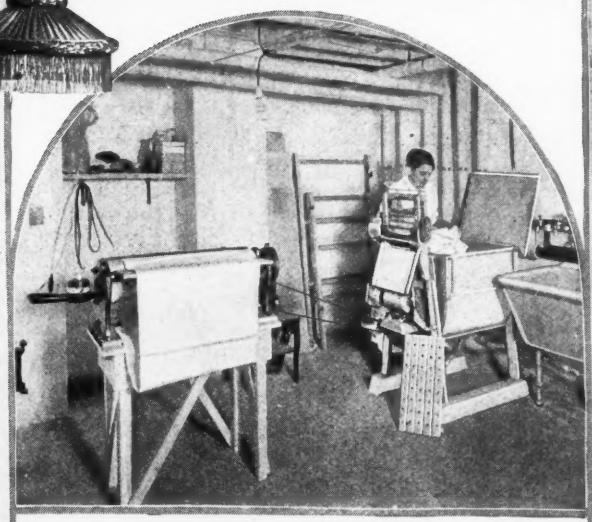


A skillet with a removable handle and an outlet for steam can be used either for baking, frying or boiling

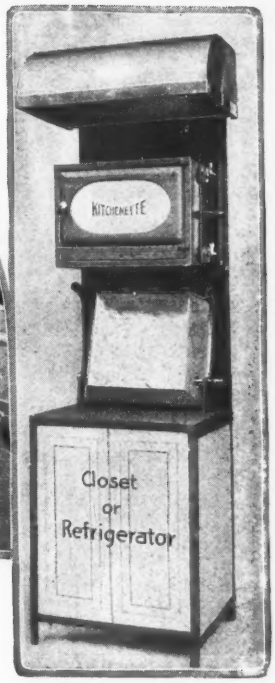
Housekeeping Made Easy



A book table provided with a lamp which may be adjusted from forty-eight to sixty inches in height. The table itself is twenty-four inches high and twelve inches square. Both table and lamp standard are of mahogany. About six books can be accommodated between the two side braces on the top of the table, and as many more on the shelf



A modern laundry in a Long Island home. The electric washer with ringer and the ironer have changed the usual wash day into wash hour



You can fold this gas range out of the way so as to use the space below it for a table. It is so made that it may be connected with flexible or fixed tubing. If flexible tubing is used the range may be disconnected and tucked away in a closet. Taking it out again and setting it up for use when needed is but the work of a moment. All parts are light in weight

Two photographs mounted on a pivot fit, back to back, in this frame. The view on each side is six by eight inches. The stand and frame are attractively finished in burnished gold

A simple and inexpensive book rest which can be adjusted in three positions for use. Two of the positions are shown here. The ledge of the device holds the pages of the opened book flat

Food For The Taking

The dogfish, the sable, the goosefish, the huge whale, the giant kelp—all are valuable sea foods that we throw away. Eat them and reduce the cost of living

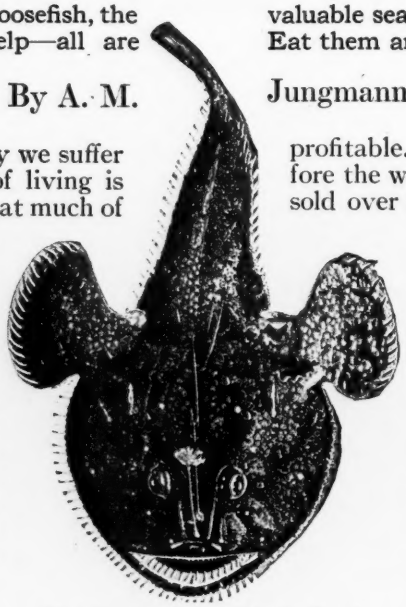
By A. M. Jungmann

ONE of the reasons why we suffer from the high cost of living is because we refuse to eat much of the food which we have. Millions of dollars' worth of wholesome, fine-flavored fish are thrown away each year. And as for the marine vegetables which can be had for the taking all along our shores—the majority of our people do not know that they exist.

Take the case of the goosefish, a food which pound for pound equals beef steak in protein (flesh-building material). Only seventy-five per cent of a pound of sirloin is edible; ninety per cent of the goosefish is edible. Hence, the goosefish equals the steak in available protein content. Yet we go on blithely throwing away ten million pounds a year of this valuable food fish.

The absurd part of this startling extravagance is that we reject the goosefish simply because we do not admire its looks.

It is so extensively used in Germany, where it appears under the name of *See-Teufel* (sea-devil), that the catch on the North Sea does not supply the demand. Before the war large quantities of this fish were imported into Germany from Great Britain. The Scotch and English fishermen found the goosefish very profitable. Figures gathered just before the war show that they annually sold over five million seven hundred thousand pounds of this fish.



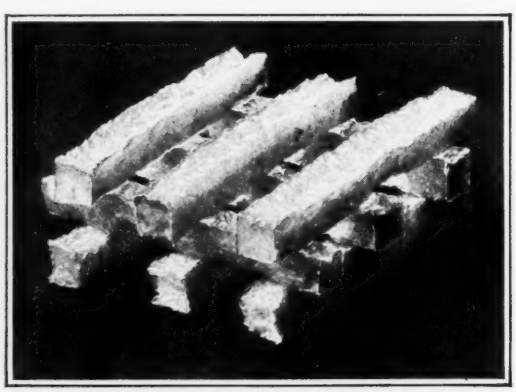
The Greedy Goosefish Is Good to Eat

The goosefish averages about three feet in length. It is not unusual, however, to find larger fish. The broad body and large head surmounted by a tuft which acts as a lure for its prey, the enormous mouth with its double row of strong teeth all tend to make its appearance repulsive. It eats any living creature it can overcome. Fishes, lobsters, squids, crabs—even water-fowl, such as ducks and geese, are all on the goosefish's bill-of-fare. To eat "like a horse" is a common expression, but to eat like a goosefish would better express the idea of a huge appetite, because the weight of a single meal of a goosefish will be half as much as the weight of the fish itself

The Mystery of the Tile Fish

Another fish which has never attained the popularity it deserves is the tilefish. It is the center of one of the most baffling marine mysteries. Nothing about this fish had ever been recorded until 1879, when a schooner fishing off Nantucket caught several thousand pounds of this large and beautiful fish. The captain of the schooner was sufficiently interested to send one of the fish to the United States Fish Commission where it was found to be new.

Efforts were made at once to establish a fishery, but before anything definite could be done the tilefish were all mysteriously killed in March, 1882. The first news of the tragedy was brought in by a skipper who said he had sailed for fifteen miles through a mass of dead and dying fish which were floating on the surface of the water. The disaster was investigated by the United States Fish Commission and it was estimated that the dead fish covered an area one hundred and seventy

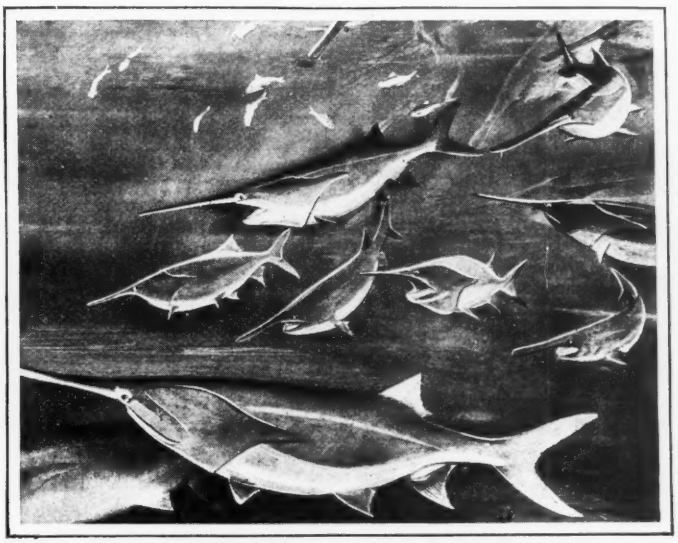


Kanten Is Made in Japan from Seaweeds

It is a sort of isinglass. It is thoroughly white, semi-transparent and shiny. It is extensively used for food in the form of jellies, candies, pastries and for anything which is prepared with gelatine. It is much superior to the common animal isinglass. Late statistics of the production of "kanten" are not available, but in 1902 three million pounds were made with a valuation of seven hundred and fifty thousand dollars

miles long and twenty-five miles wide. The number of fish to meet this untimely end was one billion, five hundred million.

This phenomenon was so amazing that the Bureau of Fisheries decided to inquire into the matter and the result of the findings indicated that the fish probably had died of chill. The tilefish, like the cod, dwells at the bottom of the sea, but as it comes of a tropical family it cannot withstand the cold as can the cod. There was evidence that the Gulf Stream had receded; as it moved off shore, the tilefish lying at the bottom were no longer protected by its warmth and found themselves in chilly water, which proved too much for them.



The Imitation Sturgeon of the South

The paddlefish frequents the bayous of the Mississippi River. It is canned and sold for sturgeon. In its fresh state it is eaten by the negroes, who are very fond of it

A few years after the disappearance of the tilefish the Gulf Stream was found to be gradually approaching the coast. In 1892, the warm water of the Gulf Stream flowed over the bottom of the New England coast and in the summer of that year the Fisheries schooner, Grampus, caught a few tilefish. But for ten years not a single fish had been found on the old grounds, although painstaking search had been made all during that time.

"What's in a Name?" The Dogfish Becomes the Grayfish

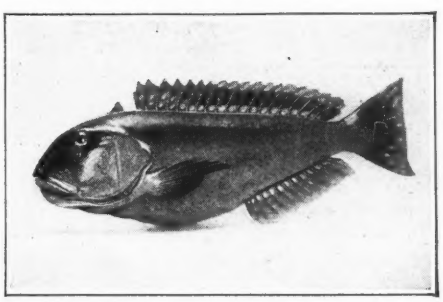
As an example of "What's in a name?" take the dogfish. As long as this excellent food fish was called by that unattractive name the public would have none of it. Now that it is known as the grayfish it is beginning to be accepted.

The grayfish is a fine looking fish, very trim and sporty with its clipper-build and smooth shining skin. It is wonderfully quick in its movements, which is necessary for a creature with its piratical propensities. It weighs when grown from five to fifteen pounds, the average for adults being seven pounds.

The hide looks scaleless, but is in reality covered with fine, sharp particles very rough to the touch. The skin is used for polishing metal, ivory and wooden articles, as it is much like emery cloth. The liver produces an oil which finds a ready market in the arts.

The utilization of these by-products makes it possible for the canner to supply the fish to the consumer at an unusually low price.

The wholesome grayfish has been eaten and enjoyed by the people living on the shores of the Mediterranean since some long distant period lost in the shadows of antiquity. Doubtless many an American sojourning in Europe has smacked his lips over a dish of savory grayfish and has wondered why we have no native fishes quite so delectable.

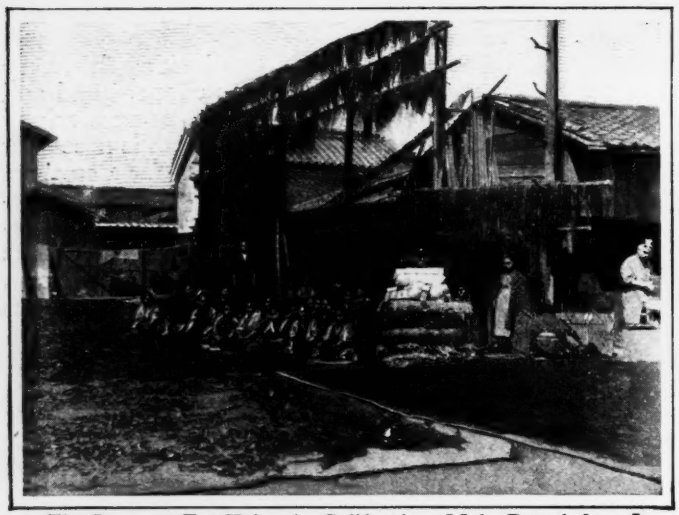


Our Newest Deep-Sea Food Fish

The tilefish should prove to be very profitable to the fisheries, because if the fresh fish are caught in such quantities that their sale in the fresh state would not pay they can be salted and smoked like finnan haddie, which, when smoked, they resemble in flavor. If these fish are ever smoked extensively a profitable by-product would be found in the sounds, or swimming bladders, as they are valuable for the production of gelatin or isinglass

The Wastefulness of California

On the Pacific coast the people are just as wasteful and extravagant as they are on the Atlantic, when it comes to refusing fine flavored



The Japanese Eat Kelp; the Californians Make Potash from It

Kelp is gathered in Japan from July to October. The seaweed is taken into open boats by hooks attached to long handles. It is dried and cured on the beach. When cured, the plants are trimmed and packed. Plants of the same size are packed together, making neat, uniform bundles

fish. There they throw away large quantities of sable fish, which until recently rejoiced in the name black cod—why, is a mystery, since it is not even related to the cod family.

The Department of Dietetics of the University of Washington states that the sable fish is "excellent from an economic aspect, as there is little waste, being almost free from bone and requiring very little time for cooking. It is suitable for the humblest home on account of its price and for the millionaire's table on account of its fineness of texture and delicious flavor."

The adult fish weighs about fifteen pounds, although much larger ones are frequently taken. They are found in abundance in the deep waters off the coast from San Francisco to Alaska. Halibut fishermen have been catching these fish for years, but they have always thrown them away because there has been no market for them.

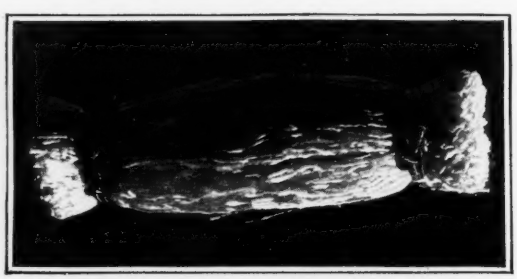
The peculiarly firm flesh of the sable fish enables it to stand shipping very well. It may be frozen and successfully shipped throughout the country, even as far east as New York.

The famous cod has a fresh water cousin known as the burbot. It is found in the lakes and larger streams of all the countries in the world. In this country it abounds from the Ohio and Missouri Rivers all the way to the Arctic regions.

The meat is very like cod. As the fish is plentiful and its price low it should become a general favorite. However, none of our people may become as fond of it as a certain Italian countess of the sixteenth century w o spent all her income on burbot.

The Burbot Belongs to the Cod Family

The burbot lurks in holes at the bottom of the waters all during the day. At night it steals forth and preys upon other fishes, crawfish, insects and fish eggs. It has a stomach which is very elastic, enabling it to consume large quantities of food at a time. But it pays for this appetite when it begins to grow old, for then it loses its slim, graceful lines and becomes heavy, flabby of flesh and "potbellied"



Seaweed Is Also the Basis of Isinglass

A bundle of "Slender Kanten," or seaweed isinglass. It is only available from December to February

Why Not Whale Steak with Currant Jelly?

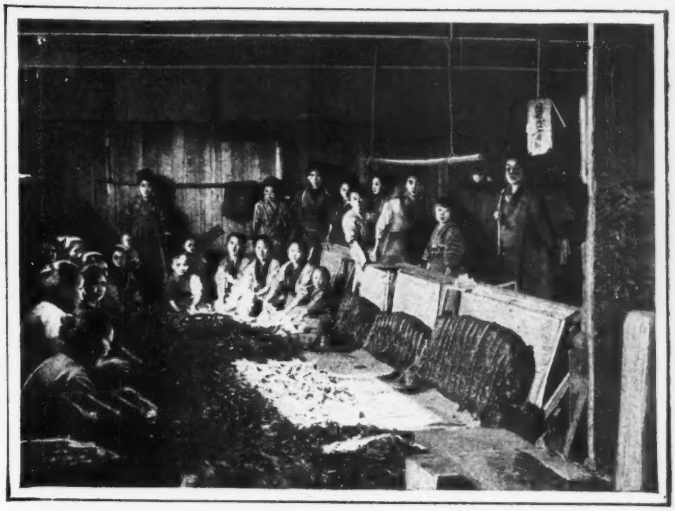
The sea produces meat which may be substituted for beef. That is to say, all the creatures which swim in the sea are not fish. Whales and porpoises are mammals just like cattle and sheep. Their flesh is really meat. Whale steak was served this summer in western hotels and met with a favorable reception. A juicy piece of sperm whale steak with currant jelly makes a fine meal. The whale steak is very like beef in texture although darker red in color. The flavor is much the same as beef. It has no slightest trace of "fishy" taste. The United States Government tests show that it contains about four per cent more protein than does beef.

In Seattle, Washington, and Portland, Oregon, whale meat has been selling in the market places for ten cents a pound. It was first put on the market in May and it has been selling steadily ever since. Whale meat has been used in Denmark to feed the soldiers.

Eating the Vegetables of the Sea

With your whale steak you might have a dish of dulse or kelp if you only knew how palatable these marine vegetables are. And you might top off your dinner with a pudding made from seaweed isinglass. In Ireland, dulse is a much favored vegetable, as is laver, which is called "sloke." Both these vegetables grow plentifully under the water along all our Atlantic coast.

Our seaweed resources are equal, if not superior, to the Japanese or those of any other country. Yet, while Japan prepares seaweeds each year which exceed $2,000,000 in value, the total value of the marine vegetables prepared in this country is $35,000.



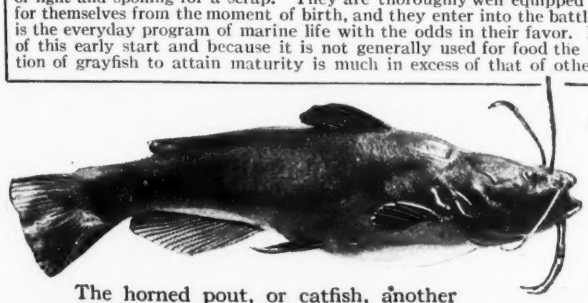
Japanese women sorting kelp. When prepared, this article is used extensively, throughout Japan and China, for food

The industry in the United States is practically confined to Massachusetts, and but a single species is used—Irish moss. It is true that in Monterey and Santa Barbara Counties in California, Chinese fishermen dry certain marine algae for food, but the value of this amounts only to about eight hundred dollars a year.

Kelp is an enormous seaplant which abounds along the Pacific coast. A full grown plant will have a stem three hundred feet in length which bears at the top an air bulb. From this bulb grow fifty or more giant leaves, each one of which will attain a length of thirty or forty feet. This plentiful vegetable is entirely ignored by us, but the Japanese prize it highly. They make what is known as "kombu" from kelp. Because it fades in the curing process, much of it is dyed green, just as French peas are dyed to give them their pleasing color. This shredded, dyed "kombu" is used as a vegetable and is cooked with soups and meats. It is even made into a sort of confection by sugaring small strips of it. "Kombu" appeals to the Occidental taste when crisp sticks of it are broken in small pieces and served as a cereal.

A Pirate of the Deep

Like the bluefish, cod and haddock, the grayfish subsists on a purely animal diet. It feeds on fish, crabs, shrimp and lobsters. The grayfish, like the goosefish, enjoys a healthy appetite. Indeed, it is so ravenous that it does not hesitate to rob fishermen's nets and trawl lines. It has splendid teeth of a knife-like sharpness and makes a general nuisance of itself by cutting to pieces fishermen's gear in its piratical efforts to get the square meal it always craves. Neither the trawl fishermen nor their brothers of the nets are spared by these unscrupulous sea thieves. Most fishes produce innumerable eggs, but the grayfish is an exception, Six or eight grayfish are born of the mother fish, not helpless as young creatures usually are, but full of fight and spoiling for a scrap. They are thoroughly well equipped to care for themselves from the moment of birth, and they enter into the battle which is the everyday program of marine life with the odds in their favor. Because of this early start and because it is not generally used for food the proportion of grayfish to attain maturity is much in excess of that of other fishes

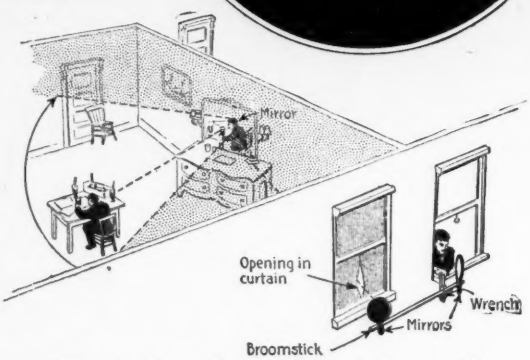


The horned pout, or catfish, another valuable article of food much despised because of its looks and its whiskers

The Broomstick Periscope—How Detectives in Kansas City Used It

THE combination of a pole, two hand mirrors, a monkey-wrench, a torn curtain and a bureau looking glass solved a mystery case in Kansas City, Missouri, which baffled the detectives for a long time. The detectives wanted to discover what was going on in a certain room.

By tying a hand mirror to each end of a short broomstick and by holding the device outside the window with a monkey wrench, the detectives were able to see inside the room. Fortunately they found opportunity first to tear a hole in the curtain.



The periscope device which rivals any of the tools used by Sherlock Holmes. The detectives arranged first to tear a hole in the curtain and adjust the mirrors

Why Are Skirts So Short? To Help the Poor Shoe Dealers

EARLY in the season manufacturers of women's dresses decided that the short, narrow skirt must be discarded. Not for puritanical reasons, but because the manufacturers of materials were losing money. "Make them long and full," was the verdict. "No!" retorted the shoe manufacturers. "Do you want to put us out of business? Make them as full as you like, but short—and shorter!" The argument waxed hot and revealed the fact that every inch added to the length of women's dresses means a loss of $10,000,000 a year to the shoe business. In the face of such appalling figures it was decided to cut the skirts off at seven, eight and nine inches from the ground, making up the deficiency in the width. The little matter of the cost of the high shoes did not disturb the manufacturers.

Music Hath Charms Even in the Desert

THE British Tommy must have his fun; otherwise he wouldn't make a good fighter. When the Tommies on the western front are given a few days' visit to "Blighty" (the soldier's name for England), they are welcomed with open arms by committees who do nothing else but make the visit at home a continuous round of pleasure and diversion. They are taken to theaters, athletic events and pink teas until, as one Tommy said, recently: "Trench life is a dull affair compared to what they put you through in Blighty."

Even the Tommies stationed on the blistering sands of Sahara must have their entertainment. In the photograph below is shown a company of soldiers transporting a piano across the Sahara sand for use at an outpost. The piano is being moved on a sand sledge, which is the same as a snow sled except that the runners are wider.

Transporting a piano across the Sahara to a British outpost. A sand sledge with wide runners takes the place of a van

Desert Sand-Shoes for the British Troops in Palestine

THE British troops in the Sinai desert, in Palestine, have found a way to make their feet as sand-worthy as the camel's. By weaving a stiff network of heavy wire and attaching it to their shoes, they are able to travel over the finest desert sand without sinking ankle-deep in it. They have adopted the principle of the snowshoe.

It is said to be physically impossible for a man to walk over desert sand for more than two days with ordinary shoes. At the end of that time the toes and heels become painfully inflamed and the skin comes off. No doubt the troops suffered untold agony before they devised the sand-shoes.

The snow-shoe principle applied to sand-shoes for traveling over the blistering desert

Loading Coal-Baskets Automatically From a Motor-Truck

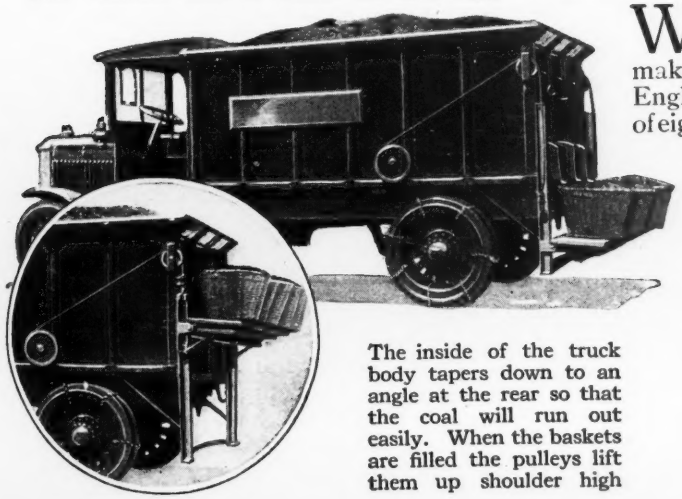
MANY residences, particularly those in the suburbs of cities, are built far back from the sidewalk so as to leave a neat lawn. Coal cannot be shot into the cellars of such houses directly from a vehicle. It must be carried in in baskets. That necessity brought forth the new motor coal-truck illustrated below.

The vehicle has a table at the rear on which are carried four large baskets, each holding two hundred pounds of coal. The table is lowered by gravity so that the baskets are level with four spouts in the rear of the truck body. Gates in these spouts are opened and the baskets filled in one operation.

After this the table and baskets are lifted up to the height of a man's shoulder by means of ropes and pulleys operated from the driver's seat by an hydraulic hoist driven from the truck engine. The men place the baskets on their backs without any lifting, carry them to the residence cellar and return with the empty baskets, after which the operation is repeated.

The rear of the body is tapered to an angle of seventy-five degrees so that the coal will run out without difficulty. The entire operation of filling the baskets and lifting them shoulder high takes seven seconds. Five tons of coal are disposed of over a sixty-foot carry, in less than twenty minutes.

With this novel body the truck is able to deliver coal at the rate of thirty-two cents a ton for labor, whereas by the former horse methods it cost fifty-two cents.



The inside of the truck body tapers down to an angle at the rear so that the coal will run out easily. When the baskets are filled the pulleys lift them up shoulder high

Five Billions to United States Is Like Three Cents to a Man With a Dollar

WHO shall say how many ten-figure loans a nation can make before she will be bankrupt? England, with an estimated wealth of eighty-five billions, has made three great loans, aggregating ten billions, the last one being the largest single loan ever floated.

Germany has made five loans since the beginning of the war, yet her wealth probably does not exceed eight billions. Considering these figures, a five-billion-dollar loan in the United States, having an estimated national wealth of two hundred and twenty billions seems small.

The Mother of the Submarine

As a complete floating naval base, the submarine mother-ship is indispensable in our submarine program because of our two long coast lines

As everyone knows,—and as Germany long ago learned to her sorrow,—the Strait of Dover has been planted and re-planted with British mines until it would be sheer suicide for a German submarine to attempt to pass through. In order to attack England's shipping, German submarines have therefore been compelled to travel all around the British Isles. In making this tedious detour, a great tax is laid upon the submarine's comparatively delicate machinery. And since this journey must be made under the water most of the way, an even greater strain falls upon the crew. If the submarine and its crew ever get back, both will be in dire need of repairs.

Here is where the mother-ship justifies her name. On returning to its assigned harbor and signaling by wireless to its parent-ship, the submarine is immediately taken in between the ship's steel hulls and is finally sheltered in the tubular compartment amidships. The compartment is water-sealed and huge pumps on the mother-ship are started forcing the water out—thus converting the compartment, in effect, into a wonderful floating drydock. The submarine's crew are received by the mother-ship and are accommodated in extra cabins especially laid aside for them. Here they can sleep on *real* beds and take their well-earned rest.

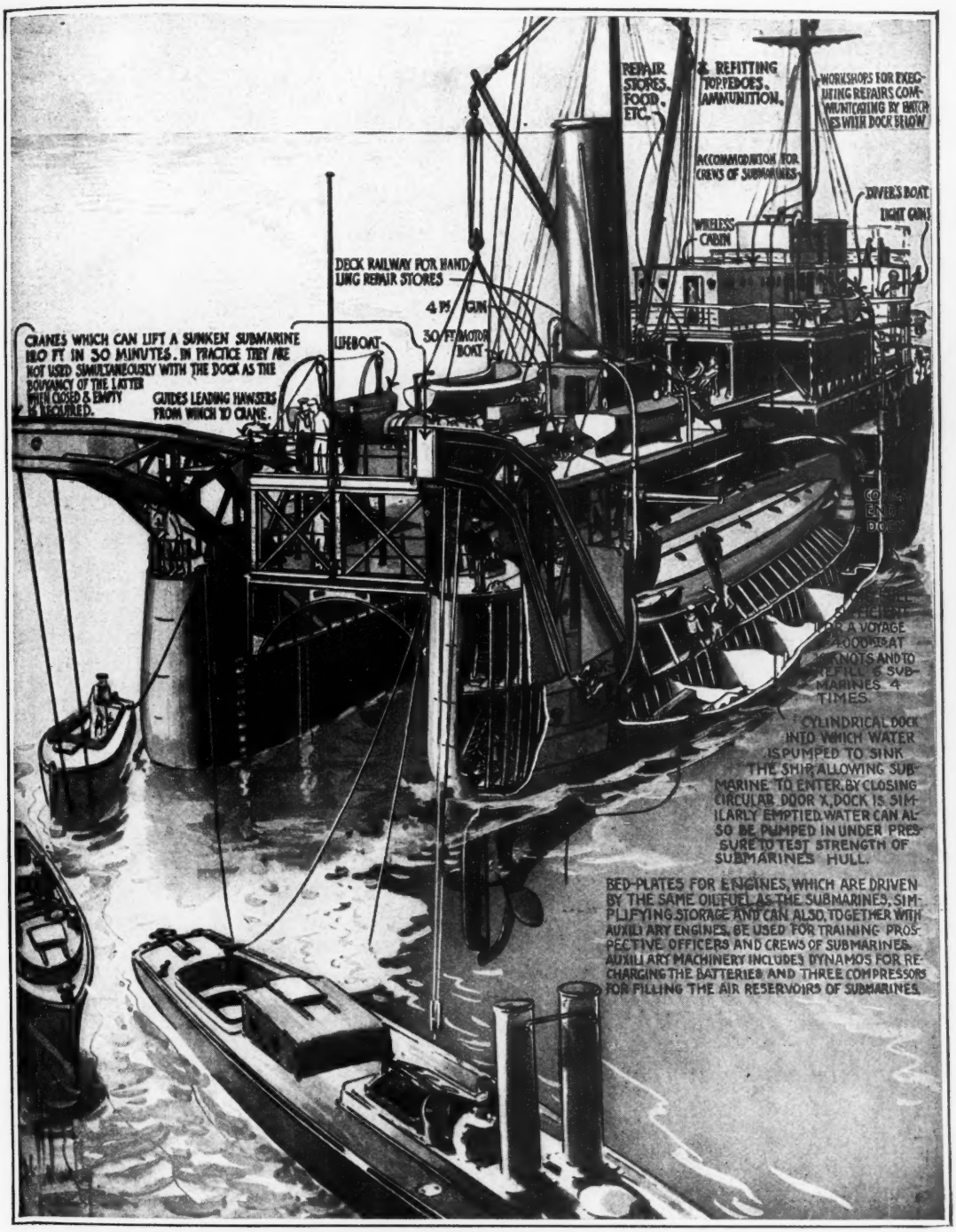
Meanwhile, the lathes and forges are busy fashioning new parts and the duplicate submarine members carried by the mother-ship are mounted in place of those worn out or damaged. The duplicate mechanisms are stored mostly on the decks. The heavy lathes, on the other hand, are mostly below; not exactly below deck, however, but more correctly, in between the two walls of steel which together make up each of the twin hulls. Occupying the remaining space between these steel walls are ballast and fuel oil tanks, torpedo and other stores. In here also, and in the hull at the front of the tubular docking compartment—which at this section looks like the hull of any ordinary ship, are the marine oil engines for driving the ship. The cast-steel propellers with which these connect project backward, one from each of the twin hulls.

In a few days' time, the submarine is completely overhauled, and her food and fuel supplies are replenished. Those of her original crew who are unable to stand the strain of the next journey are relieved by trained men on the mother-ship. When the new submarine crew have taken their places, the docking compartment is flooded, the ballast tanks trim the ship further, and the submarine takes to the sea again with renewed strength. When we consider that one ship can mother a flotilla of six submarines, scheduling four on active duty, one in reserve and one in repair, the strategic importance of this type of vessel in the present war is evident. Without putting back for new supplies, and without touching her own supplies, she can rejuvenate a complete flotilla four times!

After a submarine has been on active duty a number of months, she is likely to develop a weakened hull, a fault which cannot be detected by ordinary methods. Here again the mother-ship is of prime importance. She is specially equipped to convert her tubular compartment into a testing dock. Her powerful pumps will force the water into the testing dock until the conditions are simulated that exist at the dizzy depth of two hundred feet below the water's surface—a submarine rarely dives down more than fifty! The testing crew within the submarine are in constant communication by telephone with the men at the pumps. If any weakness has developed, leaks will soon be noticeable, and the water pressure can be relieved before further damage results. These leaks, and whatever other faults are found, are noted and subsequently repaired.

The last, but not the least important function of the parent-ship, is that of a salvage boat. If a submarine sinks within reach of divers, a mother-ship will be able to save her, provided she can be sufficiently protected from the enemy by friendly warships or by her own quick-firing guns. Mother-ships have a cruising radius of four thousand miles and they can speed towards the place of disaster at the rate of ten knots. Expert divers are ready to wrap a cable around the sunken submarine, and powerful cranes are made ready to haul it up.

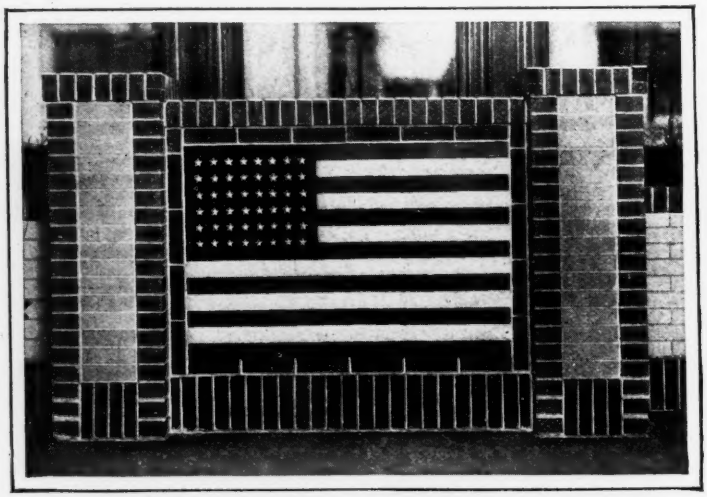
What the "Mother" of a Submarine Flotilla Looks Like


REPAIR STORES, FOOD, ETC.
& REFITTING TORPEDOES, AMMUNITION.
WORKSHOPS FOR EXECUTING REPAIRS COMMUNICATING BY HATCHES WITH DOCK BELOW
ACCOMMODATION FOR CREWS OF SUBMARINES
DIVERS BOAT
EIGHT GUNS
WIRELESS CABIN
DECK RAILWAY FOR HANDLING REPAIR STORES
4 PR. GUN
CRANES WHICH CAN LIFT A SUNKEN SUBMARINE 180 FT IN 30 MINUTES. IN PRACTICE THEY ARE NOT USED SIMULTANEOUSLY WITH THE DOCK AS THE BUOYANCY OF THE LATTER WHEN CLOSED & EMPTY IS REQUIRED.
LIFEBOAT
30 FT MOTOR BOAT
GUIDES LEADING HAWSERS FROM WINCH TO CRANE.
FOR A VOYAGE OF 4,000 MILES AT 10 KNOTS AND TO REFILL HER SUBMARINES 4 TIMES.
CYLINDRICAL DOCK INTO WHICH WATER IS PUMPED TO SINK THE SHIP, ALLOWING SUBMARINE TO ENTER. BY CLOSING CIRCULAR DOOR X, DOCK IS SIMILARLY EMPTIED. WATER CAN ALSO BE PUMPED IN UNDER PRESSURE TO TEST STRENGTH OF SUBMARINES HULL.
BED-PLATES FOR ENGINES, WHICH ARE DRIVEN BY THE SAME OIL FUEL AS THE SUBMARINES, SIMPLIFYING STORAGE AND CAN ALSO, TOGETHER WITH AUXILIARY ENGINES, BE USED FOR TRAINING PROSPECTIVE OFFICERS AND CREWS OF SUBMARINES. AUXILIARY MACHINERY INCLUDES DYNAMOS FOR RECHARGING THE BATTERIES AND THREE COMPRESSORS FOR FILLING THE AIR RESERVOIRS OF SUBMARINES.

The mother-ship of a submarine flotilla must discharge manifold duties. She is responsible for the supplying and the repairing of six submarines, keeping them in prime condition for active service. In her central testing dock, she must periodically subject each submarine to tremendous pressures so that disasters from weakened hulls are averted. In brief, she must act as a mobile naval base—a base which can furthermore salvage any sunken submarine within reach of her divers

The Star Spangled Banner in Brick —A Feat of Chicago Masons

SOMETHING out of the ordinary in the way of flags was constructed by a Chicago company recently. It is a flag of burnt-clay brick that neither time nor elements can destroy or mar. So far as we know, it is the only flag of its kind in the world. It is fully thirty-two inches high by forty-eight inches wide. The red stripes consist of red, vitrified brick, the white stripes of matt-glazed brick, and the blue stripes of dark blue-enameled brick. The stars are of brick, too. Forty-eight of them were cut from white enameled brick with chisels and were laid in the blue background with blue cement mortar.



"Old Glory" reproduced in burnt-clay brick. Even the stars are of brick. They were chiseled out and finished in white enamel

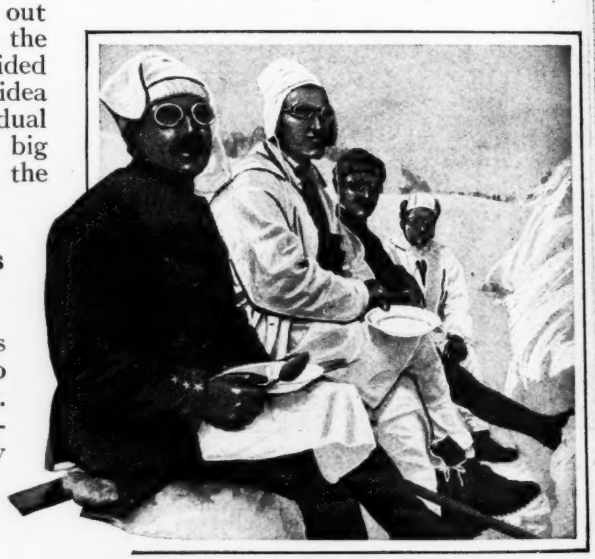
The masons who are responsible for the flag first thought of pasting stars cut out from oilcloth on the brick to represent the forty-eight States. Finally they decided not to fake the flag, and hit upon the idea of cutting the stars out of individual bricks. Needless to say, this was a big task, but the result was well worth the labor and means expended.

Italian Soldiers Paint Their Faces —But Not for Beauty

THE Italians holding down trenches in the Alps have two enemies to deal with, the Austrians and the snow. Of the two the Italians prefer to encounter the Austrians. As it is, they have to face both and get along as best they can. In order to do this they supply themselves with gunpowder and rifles for the Austrians and black grease and glasses for the sun.

The photograph shows four members of an Italian scouting party about to partake of their midday meal. Their faces and hands are besmeared with black grease to protect them against the burning rays of the sun, which are doubly strong when reflected from the snow. They prefer to use vaseline, but that is too expensive. The snow not only burns the faces of troops but it injures their eyes so that sun glasses have to be worn. Needless to say, the black grease and the sun glasses make the Italians excellent targets against a background of white snow.

However, the Alpine Italian troops do not always use grease and sun glasses. When there is hot fighting to be done in the Alps, they don snow-white suits and even paint their rifles white. In such a uniform they are practically invisible.



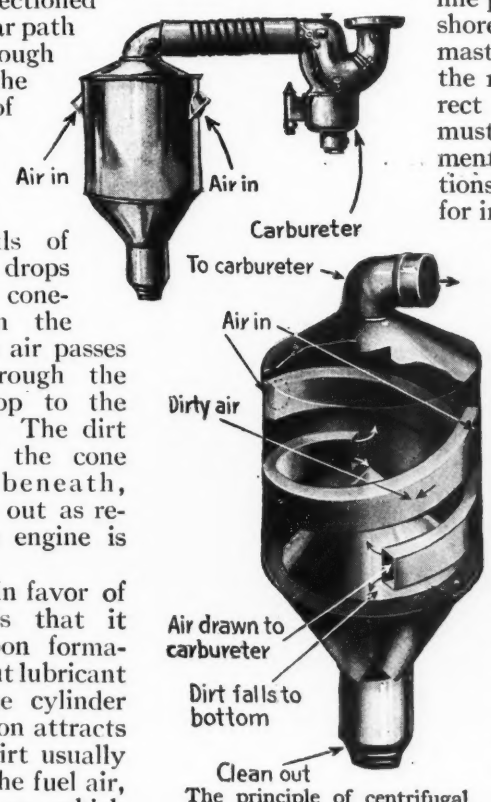
Black grease and sun glasses prevent the sun from burning the faces and injuring the eyes of the Italian troops fighting in the Alps

Cleaning the Air Fed to Automobile Engine Cylinders

OF interest to every automobilist, and to the Government whose army trucks run in convoys almost hidden in clouds of dust, is the carbureter air-cleaner shown in the illustration below. The device is distinguished by its simplicity; for it has no moving parts. By extracting the dirt and grit from the air sucked through the carbureter into the engine cylinders, excessive wear on pistons and piston rings is avoided, as well as scoring of the cylinders, pitting of the valves and cutting out of bearings.

The cleaner operates on the principle of centrifugal action. The air is sucked in near the top and down through the two curved square-sectioned tubes. The circular path of the air down through the tubes throws the heavier particles of dust to the outside so that when air and dirt are sucked through the ends of the tubes, the dirt drops down on to a cone-shaped shield in the bottom while the air passes up and out through the center of the top to the engine cylinders. The dirt slides down off the cone into a pocket beneath, which is cleaned out as required when the engine is stopped.

Another point in favor of such a cleaner is that it reduces the carbon formation. The dried out lubricant remaining in the cylinder after each explosion attracts the particles of dirt usually sucked in with the fuel air, forming points on which carbon readily collects.



The principle of centrifugal action explains the working of the carbureter air-cleaner

In circle: Smoking the rifle sight for use when firing in the sunlight. Above: Using the rifle strap as a sling-grip

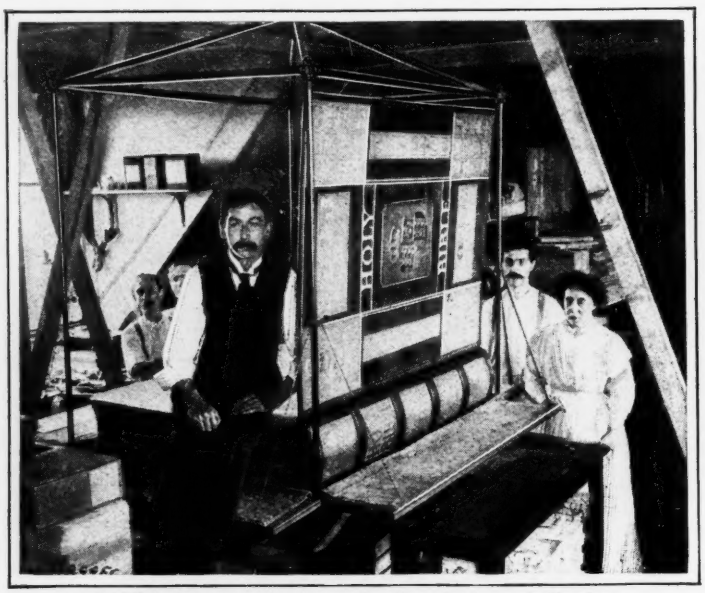
Some Rifle-Firing "Kinks" That Are Taught the West Pointers

THE average recruit who starts in at West Point knows as much about the fine points of rifle firing as a long-shoreman about flying. First he masters the elementary steps—the manual of arms and the correct firing positions. Then he must learn a thousand facts not mentioned in the "Drill Regulations." Among the rifle kinks, for instance, is the smoking of the glass rifle sights for work in the sun. By simply holding the sights over the flame of a match—or better, over an alcohol flame—a light layer of lampblack is spread over the sight which enables the soldier to fire even when he is directly facing the sun. And when his back is towards the sun, the reflected glare is eliminated so that he can work without danger to his eyes.

Another kink is the doubling up of the ordinary rifle-strap in order to use it to obtain a sling-grip. By making the sling short enough, it is possible for the left hand to obtain a vise-like grip on the rifle. This helps considerably in steadying it.

Turning a Page of This Biggest Bible Is Like Opening a Trap-Door

A MANUSCRIPT Bible measuring five feet two inches by three feet ten inches has been prepared for a Bible crusade by the Oxford University Press. When open, the book measures seven feet ten inches. It is so big and bulky that a special steel framework is necessary to keep it in shape. Turning one page is like pulling up a trap door, only the page is much lighter than a door. On the other hand, the cover of the Bible, which appears very distinctly in the accompanying photograph, is heavy. It weighs as much as twenty good-sized books. Twelve thousand persons have been engaged in preparing the Bible. Perhaps a hundred thousand will have helped before it is completed.

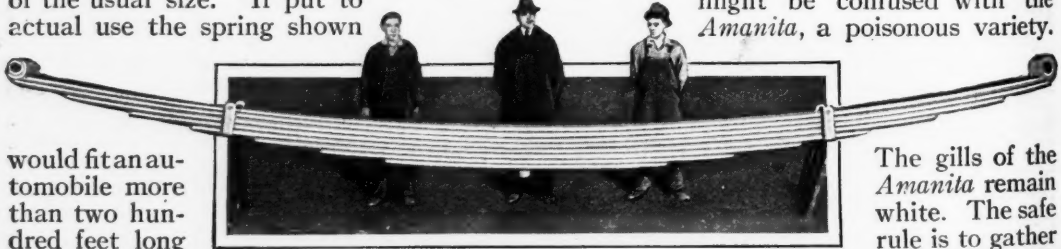


A Bible big enough for a family of giants. Twelve thousand persons have been engaged in preparing it

A Spring Big Enough for an Automobile Two Blocks Long

AN automobile spring forty-five feet long is used by a Seattle factory as an advertising sign. It is built of the same materials as an ordinary spring, and the workmanship is as accurate as in a spring of the usual size. If put to actual use the spring shown would fit an automobile more than two hundred feet long and would support a weight ten times that of the ordinary pleasure car.

At the present time the spring occupies a position above the roof of the factory. Here it attracts about as much attention as it did when a score of workmen were busy constructing it. When asked for what purpose the spring was being made, a workman facetiously remarked, "For a car to carry the man who wore the seven-league boots."

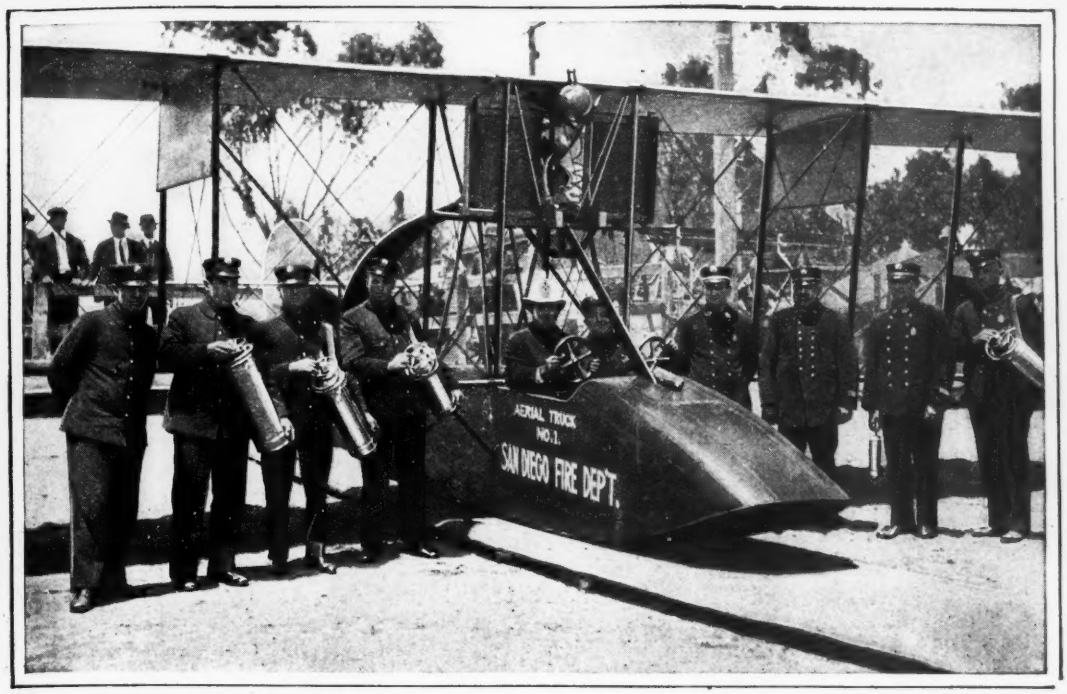


A spring big enough to support the combined weight of ten pleasure cars is used as an advertising sign by a Seattle factory

Leave the Gathering of Mushrooms to an Expert Who Knows Them

ACCORDING to specialists in the United States Department of Agriculture, there is no simple and infallible test for distinguishing between edible and poisonous mushrooms. The only safe mushrooms to eat are those that have been gathered by a collector who knows his business.

The most common edible mushroom is the *Agaricus campestris*. Its cap is fleshy and hemispherical at first but later becomes expanded and nearly flat. It is smooth and light brown or white in color. The gills are white at first, later pink, and finally a blackish-brown. The stem is stout, smooth and furnished with a ring. It is readily recognized; but before the gills turn color it might be confused with the *Amanita*, a poisonous variety. The gills of the *Amanita* remain white. The safe rule is to gather only those with colored gills.



The first aerial fire-fighting company in the world. The equipment consists mainly of chemical extinguishers. Extinguishing bombs are suggested for forest fires

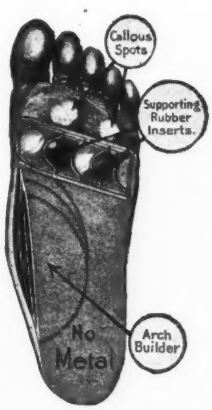
Clang! Clang! The Fire-Chief Is Coming in His Airplane

THE fire department chiefs of every city of this country have their eyes on Chief Louis Almgren, of the San Diego, California, fire department. Chief Almgren has discarded the horse and buggy and the automobile and now races through the air in an airplane when chasing fires.

When a fire box is pulled in an outlying section, the chief jumps into his flying machine and is at the scene of the blaze before the horse-drawn equipment gets around the first corner or the fire boat is going full steam ahead. His is the first aerial fire-fighting company in the world. In test flights made with the new airplane, which is a one-hundred horsepower machine of the hydroplane type, trips that ordinarily took the fire boats from twenty to thirty minutes to make were made by airplane in from two to five minutes, counting the necessary time in getting the engine started.

You Will Never Be Efficient While Your Feet Hurt You

ACCORDING to some of our best physicians many of our bodily ills are directly attributable to improperly-cared-for feet. This does not refer particularly to fashionable footgear, but rather to fallen arches, which are more common than is realized, and to the painful callous spots which prevent comfort in shoes of almost any make.



The device for supporting the arch and removing callous spots

An adjustable device for supporting the arch of the foot and for removing such callouses on the sole is shown in the accompanying photograph. It consists of a number of supports which can be placed in any desired position and adjusted as needed from time to time. To remove callouses, rubber inserts in a pocket are placed under and around the affected spot.

There are no metal parts, the material used being soft flexible leather and rubber. The cure is not an overnight one, but the relief is said to be immediate.

Those of us interested in science, engineering, invention, form a kind of guild. We should help one another. The editor of The POPULAR SCIENCE MONTHLY is willing to answer questions.

The Ideal Aerial Bomb

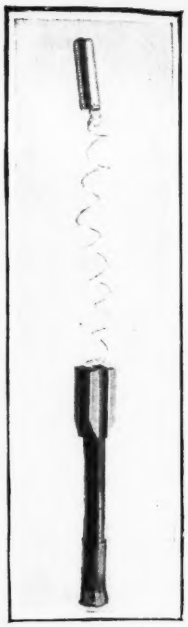
It explodes six feet above the ground regardless of the height from which it is dropped

The bomb is six feet six inches long. The diameter of the head is six inches

AN aerial bomb which explodes about six feet above the ground, regardless of the height from which it is dropped, has been tested out by the Ordnance Department and probably will be manufactured in large numbers. It is the invention of Lester P. Barlow, a former coal passer in the United States Navy who later joined Villa's forces in Mexico and was at the head of railroad shops where the rebel chief had his artillery ammunition made. While there he conceived the idea and partially perfected the device.

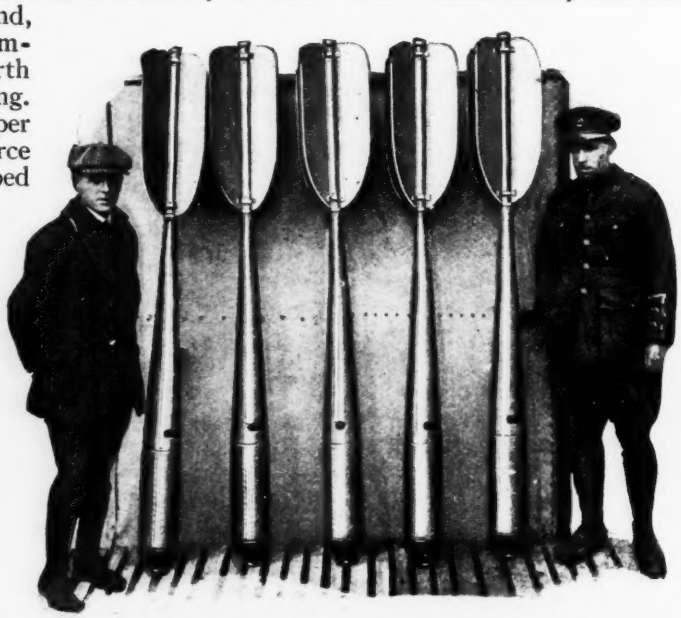
The novel feature of the bomb is that it explodes before it hits the ground, whether it is dropped from a height of two thousand feet or twenty thousand feet. The difficulty with bombs used in the past is that they have been fired by contact with the ground, burying themselves in the earth before exploding. Thus ninety per cent of the force of a bomb dropped on ordinary ground is expended against earth, instead of scattering its fragments over a wide area above ground.

Inventors have been aware of this deficiency of the tear-shaped bomb for a long time. The idea uppermost in their minds has been to develop a bomb that would explode head high and whose bursting fragments would cover a wide circle before reaching the ground. So far as is known no foreign country has such a bomb in its possession. The bomb which comes closest to realizing the maximum of efficiency, as the Ordnance Department interprets that term, is this bomb devised by Mr. Barlow.



The detonating rod sets off the detonator as soon as its point touches the earth

The above-ground explosion is made possible by a rod that protrudes from the point of the bomb after it has been dropped from the aircraft carrying it. This is about six and one-half feet long. As soon as its point touches the earth it sets into operation a detonator containing about two hundred grains of fulminate of mercury which immediately sets off the explosive.



The fin-like device at the top of each bomb is a stabilizer which keeps it true to its course during its flight

The bomb weighs about one hundred pounds. It contains about forty pounds of trinitrotoluol and the steel casing and other metal parts of the bomb, which are blown into fragments by the explosion, have a total weight of about sixty pounds. The bombs can be manufactured at a cost of about

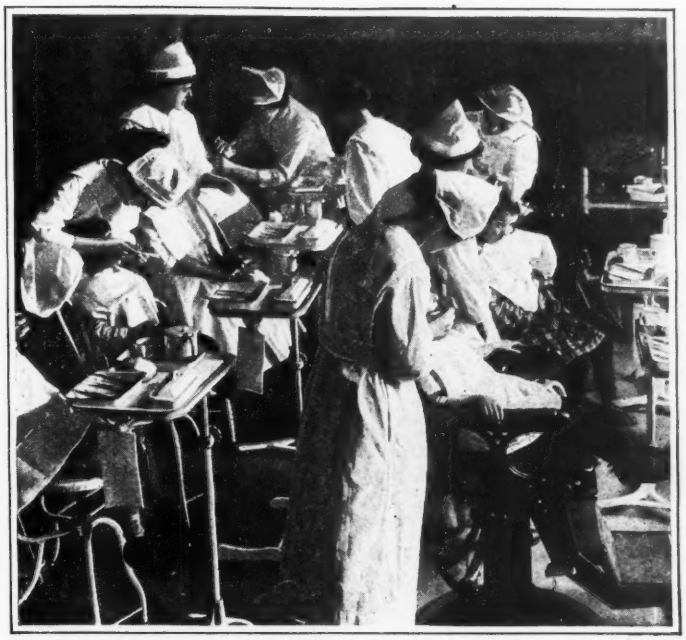
fifty dollars each exclusive of labor cost.

The bomb is about six feet six inches long and the diameter of the war head is about six inches. At its upper end there is a stabilizer which keeps it true to its course. The bomb is carried suspended in a horizontal position beneath the aircraft. When released, the end containing the explosive, being the heaviest, drops first, bringing the apparatus into a vertical position.

Having assumed this position, the action of the air operates a valve which releases a telescoped tube to which the stabilizer is attached. This extends the device to a full length of about ten and one-half feet. At the same time, the detonating rod is released from its position in the center of the bomb until it protrudes a distance of about six feet six inches below the war head, ready to set off the detonator as soon as its point touches the earth. The manner in which the detonator operates and other features of the bomb are of great military value and are being kept a secret.

It is known, however, that up until the time the bomb is dropped from the aircraft carrying it, the detonator is held in such a position that it is impossible to discharge it, so that no matter how much explosive is in the war head there is no danger. Only after the bomb starts on its way toward the earth does the detonator become operative. To demonstrate its safety features the bomb was riddled with rifle bullets during a test in England. It failed to explode.

According to Representative Tilson of Connecticut, the Government is now developing a bomb of this type to drop on submarines. For this kind of work the nose of the bomb is made to operate if it strikes a hard substance and not to operate if it hits water. In the tail of the device is a timing mechanism that can be set to let it go to any depth below the surface of the water before it explodes. Should it hit any solid object on or below the top of the water it will explode instantly, but if it continues going down through the water, when it reaches the depth for which it is set, it will explode automatically at that depth just as if it were on land. In this way it becomes the most threatening menace to the submarine yet devised.



Young girls as dental hygienists examining the teeth of several boys and girls in the Vanderbilt Clinic, New York city

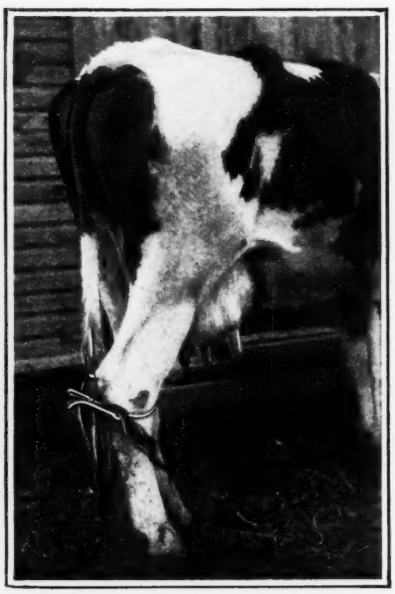
The Dental Hygienist Takes Her Place Beside the Dentist

WOMEN have assisted dentists for many years, but not until recently did it become necessary for a girl to attend a three months' course of training and then pass an examination before she could take her place beside the dentist and help him with his work. The accompanying illustration shows the graduating class of the Vanderbilt Clinic, in New York city, examining and cleaning the teeth of several youthful patients.

These girls study and do practical work in the laboratory for three months. After that they take an examination; if they pass it they are given the title of "dental hygienist." A great deal of minor work is entrusted to them, such as treating gums, cleaning the teeth and administering gas. None but high school or college graduates are accepted for training.

Subduing the Cow's Tail with a Simple Wire-Clip Device

NIGHT after night Arthur J. Thompson, of Argyle, Mich., was flogged by cows' tails. He milked two cows, which stood side by side. When milking the outside cow he got but one tail in his face, but when he milked the inside cow he got the combined swishes of both tails. Needless to say, this angered him. So thoroughly tail-flogged was he that he decided then and there to subdue the cow's tail.



The cow's tail is fastened in the clip end of the U-shaped loop

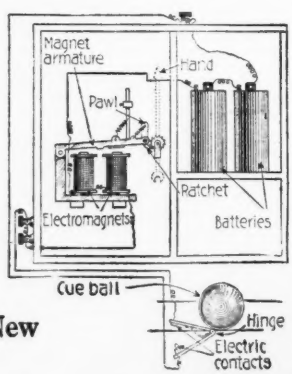
Taking a piece of wire and a pair of pliers he worked for two hours on his subduer. His first model completed he tried it on the cow "and got a crack on the head," as he tells us in a letter. But he did not stop. He worked another two hours, improved his model, tried it on the cow for the second time and lo! it kept the tail where it belonged. Several months later the Government issued him a patent.

His device is a simple U-shaped wire loop loosely fastened round the right leg of the cow, with the exterior side bent and twisted so as to form a clip to hold the tail. When placed in the clip end of the loop, the cow's tail can not be moved, nor can the cow kick with that foot.

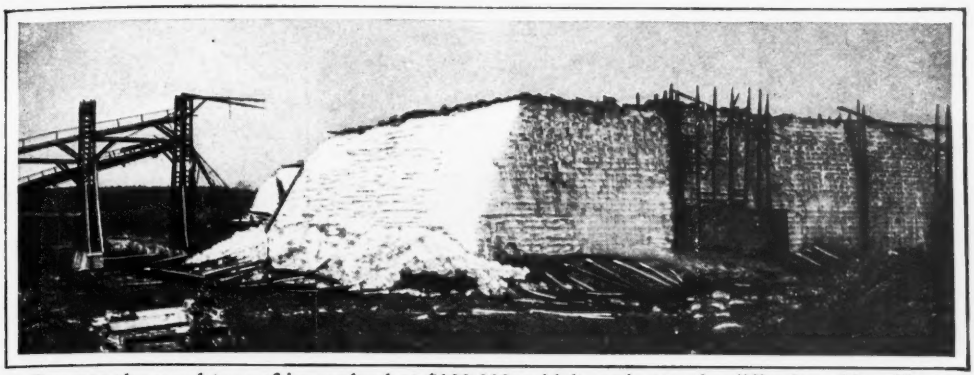
Combining Luck with Skill in a New Game of Pocket Billiards

TO win in the game of pocket billiards devised by William Heffley, of Pennsylvania, you will have to be lucky as well as skillful. His invention adds to the age-old game an electric spinning device which is operated by the ball entering into its pocket. The spinning device is likely to score you almost anything, so that a closely matched game can be made not only a matter of skill, but one which is intensely exciting.

Heffley's device can be attached to any pool table without altering its construction. Each pocket of the pool table is provided with a V-hinge baseplate at the top. Electric contacts are held on the ends of both of the halves of these baseplates. The contacts lead to dry batteries and an electromagnet in the spinning device. Thus, when you succeed in starting a ball towards any pocket, the weight of the ball as it passes over the baseplate forces the hinge arms together and closes the circuit. Instantly, the armature of the electromagnet is sharply pulled down. By means of the ratchet-and-pawl arrangement at the end of this armature, the hand on the spinning device is set whirling around in front of the score dial. The number at which the hand stops is the number of points which your pocket scores. While the number thus scored will depend solely on your luck, skill is always required to start the hand going. The device also aids in keeping the score without individual calculations.



The weight of a ball traveling towards any one of the pockets closes an electric circuit



Seventy thousand tons of ice, valued at $100,000, which, owing to the difficulty of handling, had to be left to melt in the sun after fire had destroyed the buildings in which it was stored

In an Encounter Between Fire and Ice, the Fire Won

A BOLT of lightning during a heavy rainstorm near Warnertown, Pa., recently, struck one of two huge icehouses. The resulting fire soon spread to the other icehouse, and in a short time even the inside partitions in the buildings were half burned out, surrounded with ice though they were. All that remained after the fire were two huge mountains of ice which, owing to insurance laws and other difficulties, were left to melt in the sun.

Who Would Fear Bullets in an Armor Like This?

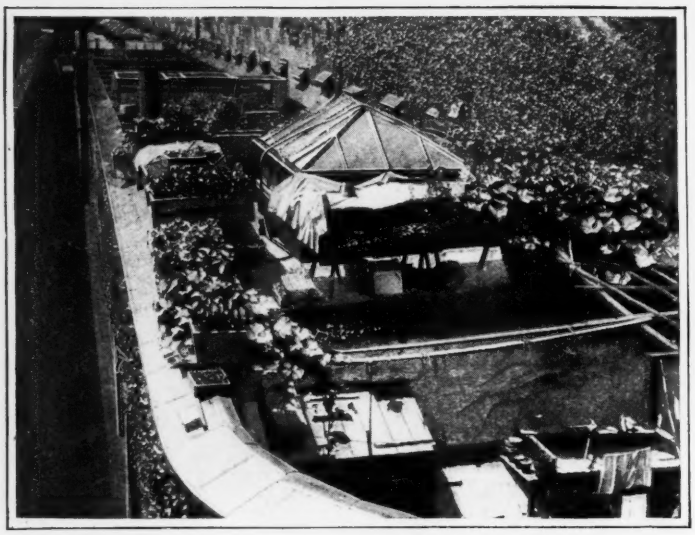
THE United States is equipping every soldier with an exact duplicate of the British type helmet made of shrapnel-proof but not rifle-proof steel. This helmet weighs only two pounds, two ounces, and is considered by the Government to be superior to the French and German helmets. In the opinion of the United States Government, the various types of helmets rank in the order of British, German, and French. The German helmet covers more of the head and is a better protection in that respect, but the German shape helmet cannot be made of the high grade material of the British helmet. The French type helmet is inferior to the other two both in shape and in resistance to shrapnel bullets. The German helmet weighs considerably more than the British, which is a disadvantage considering all the other weight the soldier is required to carry. The minimum thickness of high grade steel which would resist rifle bullets is .15 of an inch. This is four times as thick as the present helmet steel, which is considered too thick for practical purposes.

In addition to helmet protection, when especially difficult and hazardous operations over No Man's Land are contemplated, the soldiers will be equipped with body armor. This body armor consists of slightly curved steel plates sewed in a canvas sack, extending down to the knees and protecting the soldier from bursting shrapnel, but not from rifle or machine-gun bullets. This body armor, which weighs only sixteen pounds, three ounces, is strapped over the shoulders and around the body.

The steel helmets, body armor and necklets with which soldiers will be equipped for special work

Gas masks will of course be furnished for special operations, and eventually a limited quantity of necklets will be provided which are made up of twenty-four layers of Japanese silk which surround an inner lining of Japanese silk waste, the whole being encased in a canvas cover. This necklet protects the upper chest, the back of the head, and the sides of the face. Neither the necklet nor the body armor will be furnished every soldier, but will be kept in store and supplied for especially difficult work only.

Heavier body armor, which would be proof against rifle bullets as well as shrapnel, has been tried by all the belligerent nations but so far has not been generally adopted because it weighs fifty-five pounds.



Under an agricultural expert the prisoners of a Philadelphia penitentiary are planting vegetables on the prison roof

A Penitentiary Roof Garden—An Example of Scientific Farming

THE very flourishing roof garden shown above is not over the top floor of any gilded hotel, or millionaires' club. It surmounts a very different kind of hostelry—the Eastern Penitentiary, in Philadelphia.

There the convicts are cultivating what might be called, according to the times, a "war garden"; but as far as the men themselves are concerned, the open air occupation and the pride in their fine crops afford the prisoners such real satisfaction, akin to pleasure, that the place seems in itself a peace garden.

The men are not chosen and sent to this work. Of his own volition any of these future scientific farmers may make application for enrollment in the class of agriculture which is taught in the penitentiary. Having been enrolled, the member of the class attends three lectures a week given at the prison by a professor of the State College of Pennsylvania, who is a specialist in agriculture. Between lectures the student has the benefit of an additional correspondence course on the same subject. But the most appreciated part of this undertaking in the necessarily monotonous lives of the prisoners is the practical demonstration of the course, as shown in the roof garden.

Robust radishes, crisp lettuce, the bountiful bean and other vegetables in common usage are planted and flourish under the scientific cultivation and lend interest and variety to the prison bill-of-fare.

Newspaper Torches to Take the Place of Candles

IF you want to do your bit toward making the world safe for democracy and don't know how to do it, you might take up the work started by Mrs. Edward Cushee, of New York city. She is making torches for our troops who will soon hold a sector of trenches in France. The torches are to take the place of candles, and they are made of old newspapers and paraffin.

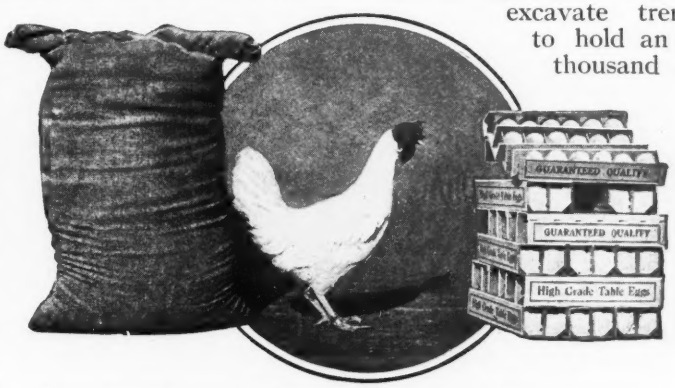
Making newspaper candles. Mrs. Cushee rolls the strips, ties each one securely and boils them in paraffin

To make one torch she takes six strips of newspaper, two columns wide, and rolls them up, tying them securely with cord. After boiling each roll of paper in paraffin for twenty minutes it is ready to light. It will burn for forty-five minutes and give off a better light than the ordinary candle.

In this "bit" of patriotic endeavor the boys and girls can also lend a hand—the boys to collect the old papers, and the girls to cut the paper into strips and roll them.

An Efficient Hen Is an Investment Paying 150 Per Cent

INTENT upon an increase in the egg and poultry production in Texas, the department of poultry husbandry in the State Agricultural and Mechanical College has prepared a photograph which visualizes for the farmers, and the city man as well, the wonderful earning possibilities of the hen as an industrial machine.



From seventy pounds of poultry food a good hen will produce about one hundred and fifty eggs in the course of a year

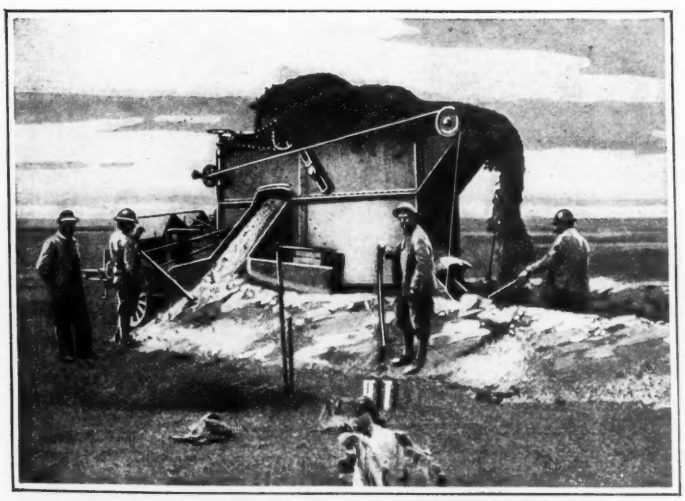
Considered industrially, says the department, the hen is a very efficient machine. From seventy pounds of feed costing about three cents per pound, a good hen will produce in the course of a year from 150 to 160 eggs, which are worth just now about three or four cents each.

An Army Burrows Itself in the Ground by Machinery

MECHANICAL trench-diggers are not new, either in this country or in Europe. About two years ago the first machines to reach Europe were put to work excavating trenches behind the French lines. They were notably successful, and attracted world-wide attention. Since that time numbers of trench-diggers have been employed on the battlefield, until now they are to be seen everywhere.

In an eight-hour day one digger can excavate trenches sufficient to hold an army of seven thousand men. It would take the seven thousand troops two days to dig the same length of trenches. Of course, the digger makes better progress where the earth is free from large stones and obstructions.

The accompanying photograph shows a digger of the kind generally used. Steel buckets attached to an endless chain dig the dirt and carry it up a side-chute where the dirt is dumped. The matting of leaves and branches which covers the machine is put there to deceive enemy airmen.



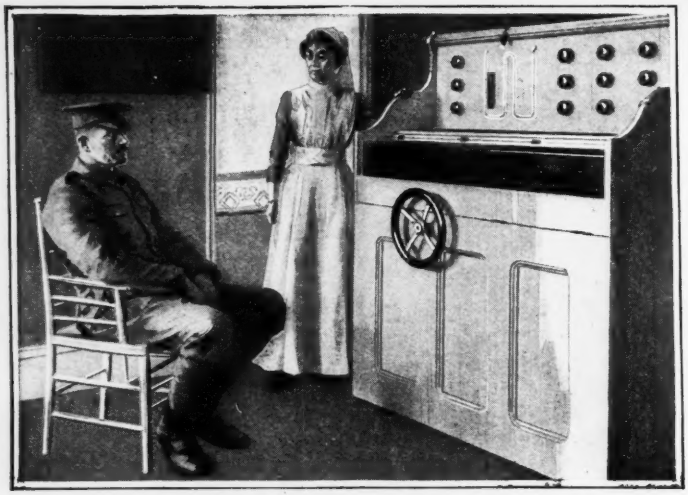
A modern trench-digging machine excavating a trench on French soil. The machine top is decorated with camouflage

Checking Insect Ravages with Armies of Enemy Insects

ONE hundred million dollars are lost to the United States every year due to the ravages of insects in crops. Half these insects were imported.

Though insecticides are useful, they are not effective under all conditions. The most satisfactory results have been obtained by introducing other insects which feed upon the undesirable foreign pests.

The threatened destruction of California's orange groves was arrested by the importation from Australia of a certain species of ladybird. The tiny workers were shipped in tin boxes, placed on ice. Once released in the atmosphere of southern California, they set about their appointed duty with such avidity and multiplied so rapidly that the pests were virtually wiped out in a very short time.



Testing the hearing of a soldier with the aid of a machine which regulates the length of sound waves

Buy Good Meat and Chop It Yourself

TWO series of investigations of ten samples each of Hamburger steak, made by the Department of Agriculture, revealed the fact that six samples of the first and five of the second series yielded counts of more than ten million microbes per gram. A great many different kinds of bacteria were found and the conclusion was reached that a large amount of Hamburger steak sold in the market is unfit for food. The Department advises that the housewife buy good cuts and chop it herself.

Deafened by Shell Fire, but Cured by a New Sound Machine

WHEN the big guns fire, not only are men before it killed, but hundreds of those behind it lose their hearing, due to the terrific noise of the explosion. The roar of a barrage fire is like a million boiler factories plus a hundred thousand pneumatic riveters. Little wonder is it that the ears can not withstand the noise.

In Europe are thousands of shell-deafened soldiers. In the accompanying photograph a soldier is shown facing an apparatus for graduating and applying the sound waves. With the aid of this machine the nurse is able to know just how deaf her patient is and to what sounds he responds most quickly. It is a slow and painstaking method of treatment, but it has resulted in a number of cured cases.

In fact, the deafness resulting from the battle noises is, in the majority of cases, only temporary.

Anchoring the Fisherman to the Fishing Pier

AFTER several fishermen had been pulled off the Redondo Beach pier, near Los Angeles, California, by large fish, the city built a new pier with special provisions for keeping fishermen anchored to it so that "the biggest fish that ever was caught" will no longer be able to get away with bait, hook and line as has so often happened in the past.

The pier is constructed of reinforced concrete. Around its outer edge is a seat for the fishermen, and a concrete rim on the foot rest enables the men to hook their boot heels over it while fishing.

Fish weighing as much as two hundred and ninety pounds have been caught from this pier even before it was made safe for the fishermen. The big fish haven't called that way lately. But when they do they will find the fishermen anchored to their posts, ready to pull them on land.

A fishing pier with a seat and a foot rest to prevent the men from being pulled overboard

Paddle Your Own Canoe—But Do It Mechanically

VENICE, in California, gets its name from its resemblance to Venice in Italy. Its streets are canals, and everybody travels about in boats. Ralph Johnson, a thirteen-year-old resident of the town, had a "cranky" little canoe that he built at home in his basement workshop. The craft is but ten feet in length, but wielding a paddle is slow, back-breaking, laborious business. So Ralph secured an old bicycle rear hub and converted it into a neat four-bladed paddle-wheel. The wheel was then mounted on wooden forks, and securely bolted over the rear deck of the canoe. Three bicycle chains were stretched between the sprocket of the paddle-wheel and a bicycle-crank hanger mounted in the cockpit athwart the gunwales. The pedal was removed from the crank-hanger and a handle substituted. The tiny craft was also fitted with a rudder, which, by wire controls, is operated from left to right by the forward or backward movement of a lever convenient to the lad's left hand.

Instead of bending over a paddle, Ralph now cruises about, turning the crank in the cockpit of his boat as easily as he would operate a hand organ. With his left hand he steers with the rudder. Instead of laboring along at four miles an hour, he now travels at the rate of eight miles an hour with less effort.

A bloody finish with the revolver machine-guns. At right: Detail of the attachment

Close-up Fighting with the Revolver Machine-Gun

AN Englishman, Charles J. Cooke, has invented a new magazine attachment for the automatic revolver.

The attachment is simply a holder which enables a number of stored magazines to be fed into the revolver as fast as they are needed. Such an "automatic" as the Colt .45 is pushed into the saddle on the upper end of the holder. When the eight shots have been fired, the usual ejecting spring is pressed; the empty magazine drops from the gun down into the slot in the holder, and is ejected. Instantly, one of the full magazines held in readiness in the bottom of the holder is pushed up into place. When this magazine is exhausted, the two others can be fed into the hollow end of the revolver. A bayonet is placed on the lower end for hand-to-hand fighting.

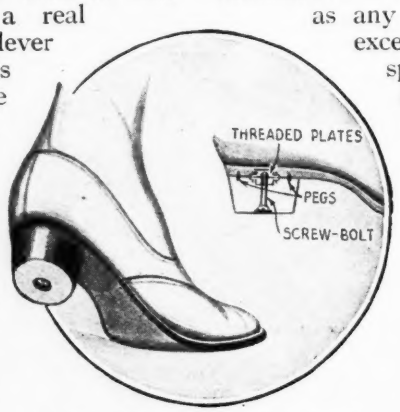
The length of such an attachment would be slightly over twelve inches.

Ralph propels his boat by turning a crank in the cockpit. With his left hand he keeps the boat on its course

A Heel Which Will Wear Evenly All Around

NINE hundred and ninety-nine persons out of a thousand wear down the heels of their shoes at the sides. The result—weak ankles and a crooked and slothful step. It took a real genius to think of the clever method of correcting this which is illustrated in the accompanying photograph. The rotating heel! All you need do when your heel becomes side-worn is to turn it around and let the heel wear down on the side opposite! But don't wait until it is very lopsided.

A short but heavy bolt, screwing through threaded plates into the heel and into the shoe, holds the heel firmly on.



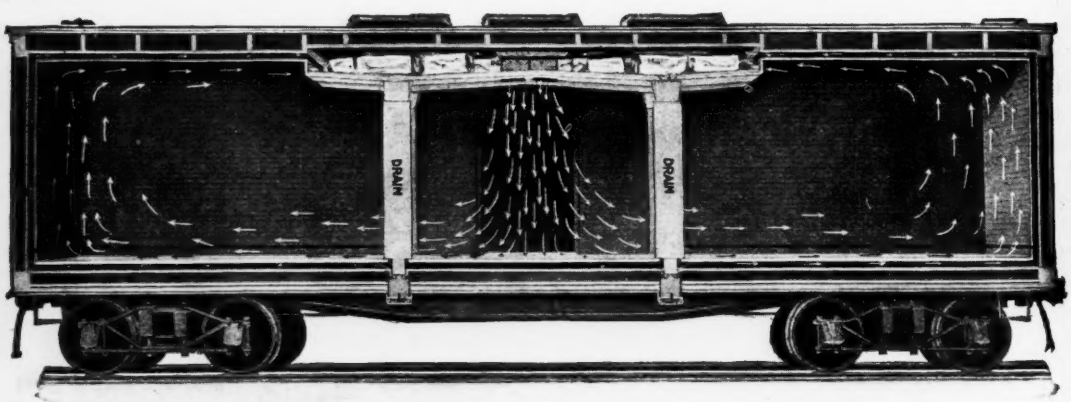
If your heel becomes too much worn on one side, just turn it around and wear it down on the other to keep an even surface

At Last! A Refrigerator Car That Really Works

WERE it not for refrigerator cars, we could not tickle our palates with out-of-season delicacies and would have to satisfy ourselves with the fruit and vegetables that grow in our own particular sections of the country, leaving California fruits for the Californians and Florida products for the southerners. And yet the producers and wholesalers claim that refrigerator cars are not at all what they ought to be.

No wonder, then, that a new type of car has been designed to meet the requirements of transportation and weather conditions, which promises to eliminate much of the loss now incurred. This new type of car is a combination refrigerator and ventilator. In construction it is the same as any ordinary refrigerator car, except that in it a live-air space is provided at the sides, ends, floor and ceiling. By means of this live-air space a wall of refrigerated air completely surrounds the interior of the car.

The ice box is located in the center of the car directly under the roof, instead of in the ends of the car, which makes it possible to carry twenty per cent more freight. It has three openings into the car, one at each end and one in the center. Entering the center opening, the cold air falls to the floor and is spread out over the car towards each end. The warm air rises and enters the ice box through a netting at the end, where it is cooled and again passes through the opening in the center of the ice box into the car chamber. The cold air is also drawn into the live-air space through the opening in the sides and ends of the car by the rising warm air which passes through this space to the ice box, where it is again cooled and discharged through the middle opening of the ice box. This has a drying effect and gives the proper refrigeration.

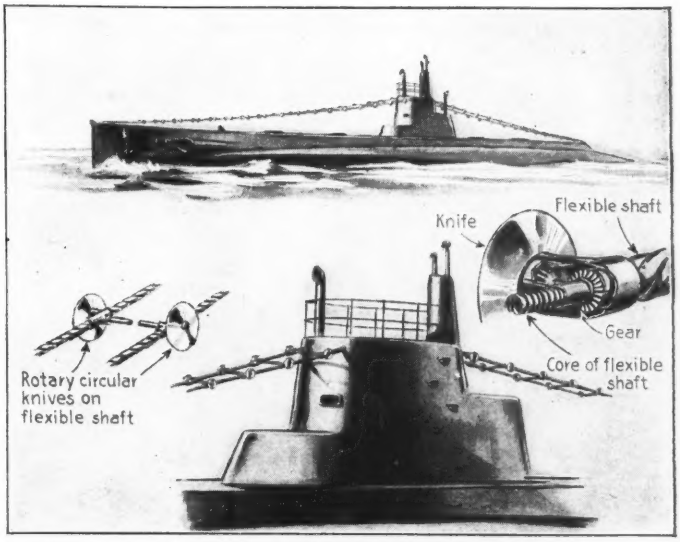


The warm air enters the ice chamber through a netting at the end of the chamber. After it has been cooled by passing over the ice it passes downward through the opening in the center of the ice chamber into the car. As it gradually loses its cold it rises to the top again

How the U-Boats Get Through the Nets

They are equipped with remarkable motor-driven circular knives and with steel flanges that spread out like doors

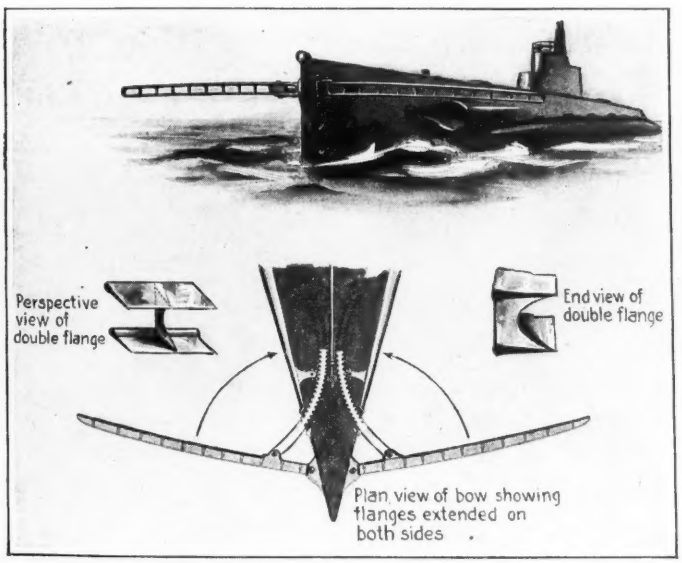
FROM reports that reach us from Europe we learn that Germany has equipped some of her U-boats with ingenious devices to enable them to cut their way through submarine nets. One boat with a double flange of thin sheet steel protruding from both sides of the bow is said to have been destroyed by shell fire and the device itself, practically intact, is said to be in the hands of the British Admiralty. A second boat, equipped with heavy motor-driven circular knives attached to steel hawsers, torpedoed a merchantman, and the captain, while in a small boat, made a drawing of the device for the Admiralty.



The net-cutting device consists of heavy circular knives attached to steel hawsers extending from bow to stern

The accompanying illustration gives a clear idea of these net-cutters. The double flange of thin sheet steel which protrudes from both sides of the bow of the submarine is operated by electrically-controlled gears. The flanges spread on either side of the bow to a distance of eighteen feet, or thirty-six feet in all, whenever the nose of the vessel touches an obstruction. Their action is said to be automatic, although an operator within the boat can extend or withdraw the device at any time, by moving two heavy metal arms.

The U-boat equipped with the circular knives is obviously far better able to cut its way through a net than the boat just described. It does not bother about a device at the bow, figuring, no doubt, that the sharp nose of the vessel and its rounded hull are sufficient to get through a net or stop the boat before it becomes entangled. However, it does not permit its conning tower to go unprotected. Several strands of stout steel hawsers containing motor-driven knives, a foot in diameter and placed about a foot apart, are stretched from the bow through the conning tower to the stern. Striking a net, the knives would revolve on a flexible shaft.

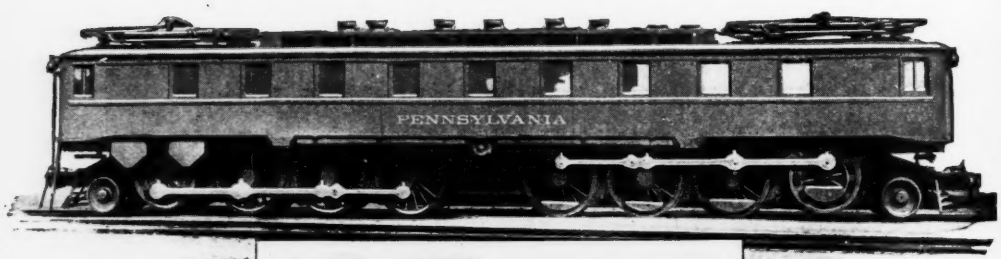


The double flanges of steel protruding from both sides of the bow are operated by electrically-controlled gears

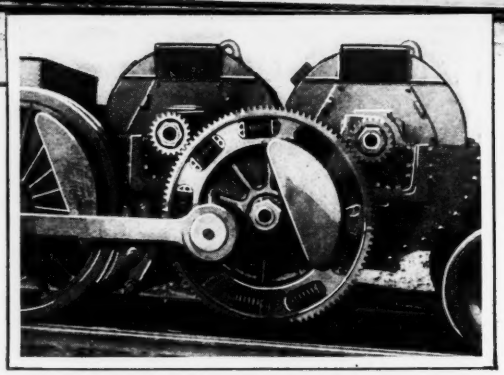
The Most Powerful Locomotive in the World

It weighs 260 tons; it is 76 feet long, and it takes current from a trolley wire no bigger than a lead pencil

By William H. Easton



The power of this locomotive is equal to that of one hundred trolley cars, or 14,000 horses, or 56,000 of the strongest men. It consumes enough current to light over 200,000 25-watt electric lamps; and many a town of 25,000 inhabitants has an electric plant of smaller capacity. This is because high voltage is used in distributing the strong electric current



It Rides Easier Than a Steam Locomotive

Each gear wheel carries a set of coiled springs. The reason for these springs is as follows: When a steam engine starts, the piston does not move with a sudden blow, because there is a cushion of steam behind it which is compressed and eases the shock. But a motor, in endeavoring to start a heavy train through a solid gear train, strikes its gears sharply and thus sets up heavy stresses. By the use of these springs, a cushion is introduced between motor and driving wheels

A glance at the illustration shows apparently eight driving wheels on each side, but there are actually only six. The wheels on each end are gears which are driven by the motors and which in turn drive the driving wheels through the connecting rods. By this arrangement, the motors can be located up in the cab and not down on the axles as in a trolley car

THOUGH hardly more impressive in appearance than an ordinary baggage car, the electric locomotive illustrated has the distinction of being by far the most powerful thing on wheels. Exerting its maximum effort, it can develop 7,000 horsepower, which is fifty per cent more than its closest rival, also an electric, can do.

It is not necessary for the entire main line of railroad to become congested before trouble is experienced, for, since a passage is no wider than its narrowest point, one congested section sets the limit to the capacity of the whole.

Such a section exists between Altoona and Johnstown, Pa., where the freight traffic is unusually heavy, amounting to 300,000 tons a day. Trains over this division must push up steep grades, pass around the famous Horseshoe Curve, and run through a long tunnel. Though the railroad is not particularly embarrassed at present, it is taking no chances, and some time in the future its new huge electric locomotive, with many more like it, will be handling the traffic through this "neck of the bottle," as such a section is graphically called.

Trains so long that three of the largest steam locomotives can barely move them will be rushed up the grades by two electric locomotives at twenty miles an hour. In this way the capacity of the division will be more than doubled and all danger of congestion here will be removed for many years to come.

One peculiarity of the electric locomotive is that its speed of twenty miles an hour cannot be exceeded whether running on electric power or coasting down hill. In the latter case the motors act as generators and return current to the line, and since power is required to generate current, a most effective braking action results which prevents runaways. At the same time the coasting speed can be regulated by the controllers, just as is the speed under power. Air brakes are therefore not needed while coasting and are simply held for emergency use and for bringing the train to a full stop.

The Candle Still Flourishes Even in This Electric Age

NOWADAYS we think of light in terms of electricity or gas lamps, but it will surprise some to learn that the average daily expenditure for candles in this country alone this year will be about sixty-seven thousand dollars. On this scale the valuation of the 1917 production of candles in the United States will total a round twenty million dollars.

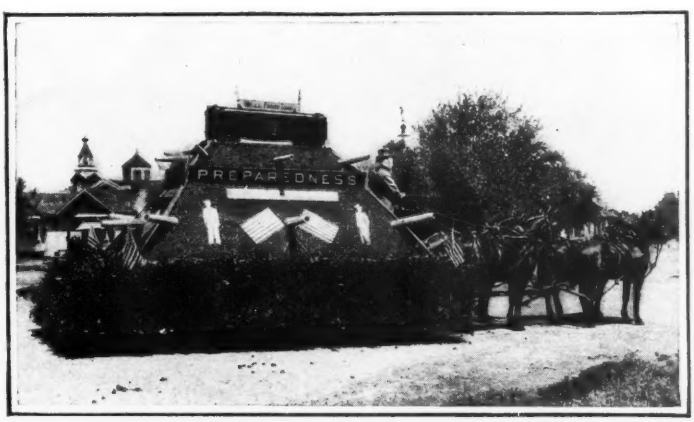
This crane, attached to an idle dirt wagon and operated by a crank, will pick up and empty the largest garbage cans

A Patriotic Float Made of Raisins to Represent a "Tank"

FRESNO, which is the center of the California raisin industry, each year in May holds a "Raisin Day" celebration, an important feature of which is a parade. This year it was given over to a patriotic display and many remarkable floats moved in the procession.

The float which won first prize as an industrial display was entered by one of the express companies. It was made up as a "tank," twenty feet long, fourteen feet wide and thirteen feet high. The float was built up solid with raisins. Out of the float projected the muzzles of fifteen dummy cannon. On top was a miniature refrigerator car. The float was drawn by four bay horses and driven by "Uncle Sam."

Three hundred and fifty pounds of raisins were required for the body alone. The bottom of the float was covered with huckleberry greens and poppies.



The float was built up solid with raisins—just raisins. The bottom was covered with huckleberry greens and poppies

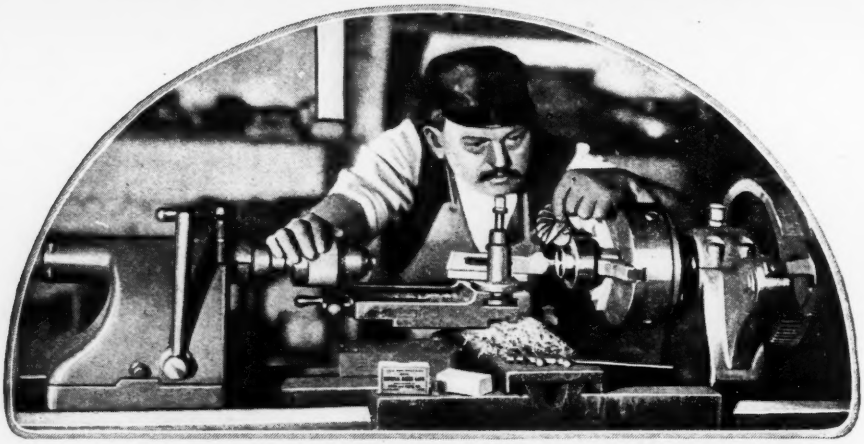
Converting the Dirt Wagon Into an Efficient Garbage Collector

WILLIAM M. WALSH, a highway commissioner at Grand Rapids, Michigan, holds the patents on a novel scheme which enables him to convert any of the city's idle dirt wagons into a more-than-ordinarily efficient garbage collector. His idea involves the use of a small crane by means of which the driver can lift the largest garbage cans into his wagon with little effort.

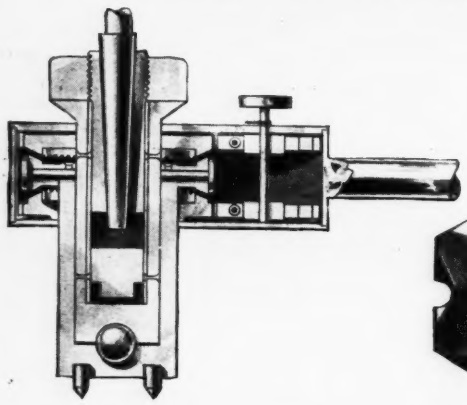
The movable crane is secured against the driver's seat and carries two tongs for grappling the garbage can. By turning a crank while standing on the ground, the two tong cables are wound upon a drum, and the can is slowly lifted. On reaching the top of the crane, the driver fastens his crank upon another shaft which operates the cable connecting with the bottom of the garbage can. Turning this shaft tilts the can upward and empties it.

All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you.

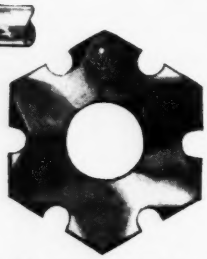
Do It with Tools and Machinery



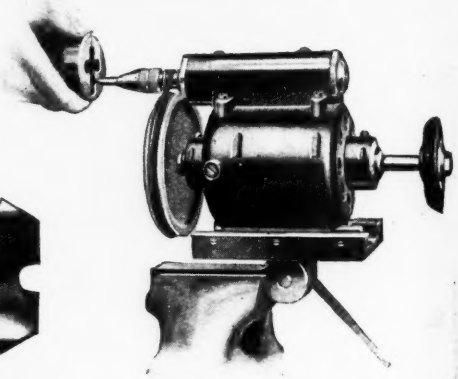
A radius gage for measuring the concave and convex surfaces of tools and dies. Instead of having small leaves it has eight small blades



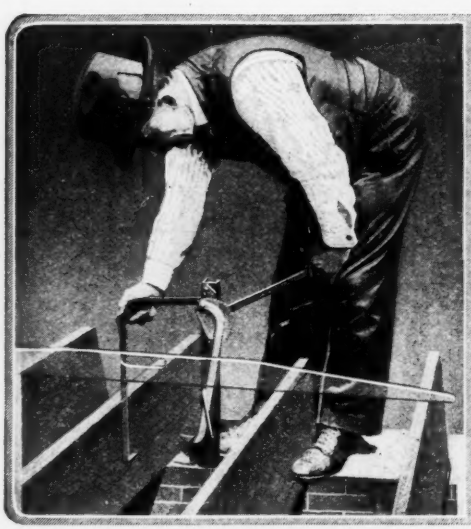
A brick and concrete drill made of a steel tube or segment of pipe. It is cut off at an angle, as shown



A lock washer which overcomes the loosening of nuts by vibration. It is made in hexagon shape



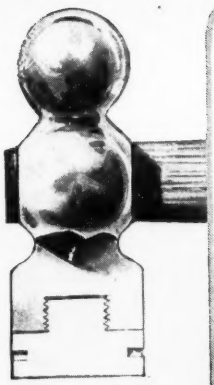
An attachment for regrinding thread-cutting dies of button type or lapping out holes in punches



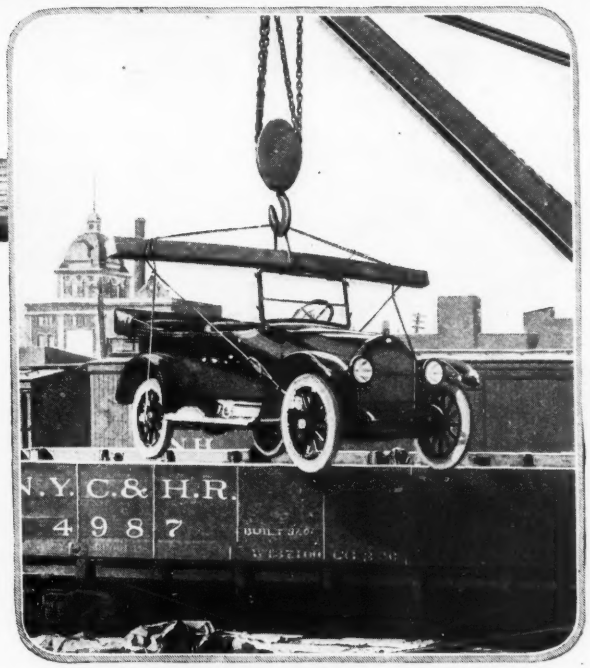
A new joist lifter. The handle is raised until the dog engages the tooth

Daniel Boone up to date. When the fire will not start use the automobile pump

Do It with Tools and Machinery



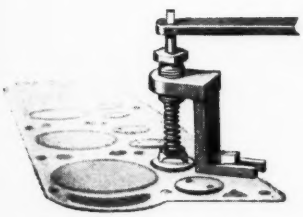
A hammer with removable faces of any desired size or shape, of steel, copper or other soft metal to suit different work



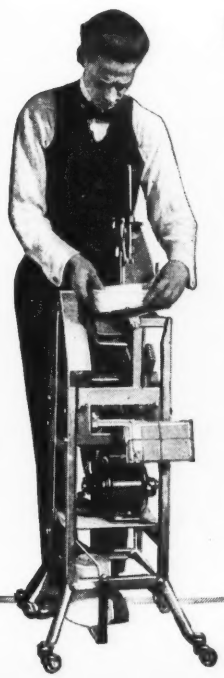
A tackle for unloading automobiles. The ropes are adjusted so as to lift vertically on each of the four wheels. The main member is a scantling suspended lengthwise of the automobile

The same hammer at left with a steel face for ordinary work requiring heavy pounding. Other faces may be substituted

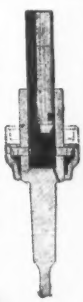
A boiler thermostat for indicating heat in chemical vats. A rod extending the length of the outer shell supports the bimetallic strip



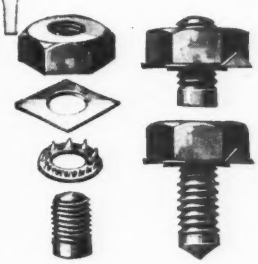
Above: A new valve grinder designed for engines equipped with valve caps



In center: A new machine used in post-offices for tying envelopes into packages.



A quick-action chuck with which a rotative tool can be removed and another inserted while the machine spindle is revolving



Above: A nut lock which prevents a nut from backing off from a bolt

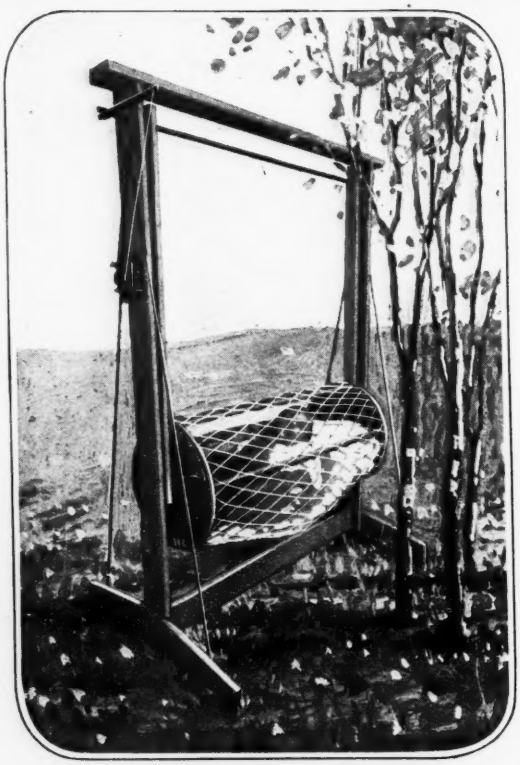
It ties from twenty-five to thirty bundles a minute with a non-slip knot

Rock-a-Bye Baby—In Your Self-Operated Cradle

SHELDON D. Vanderburgh, of Hastings-on-Hudson, New York, has a baby. The baby wouldn't go to sleep, and it was a thirty-eight-pound baby, too. The mother and father tried both crib and go-cart, but the baby wouldn't stay in them. It was impossible for the mother to rock it to sleep. She was too busy. What was to be done? Invent a new cradle, of course.

Mr. Vanderburgh decided upon a cradle hammock. He fastened the netting to end pieces to keep the cradle in shape and then suspended it from a shaft by means of two side arms. With the shaft journaled to vertical standards he had a safe and sane cradle which could be opened, basket-fashion, to receive bedding and baby and then closed down securely. At first he was satisfied with rocking the cradle back and forth. Then the idea struck him that a clock-spring motor could do the same thing.

Accordingly, he mounted a motor on a standard. It operates a rod which in turn rotates a crank arm attached to the shaft. This imparts a steady but very gentle rocking motion to the cradle. The ticking of the clock also helps in lulling the child to sleep. When wound up the mechanism will rock for two hours without further attention; at the end of which time the nap will probably be over and both baby and mother in good humor.



The automatic cradle, made of hammock net, is rocked by the aid of a clock-spring motor which imparts to it a gentle, steady swing

Even the Animals in the Zoo Feel the Effects of the War

THE war has laid a heavy hand upon the animals in the London Zoo. The places of those that have died have not been filled and many not-so-rare specimens have been killed off to save the cost of feeding and caring for them.

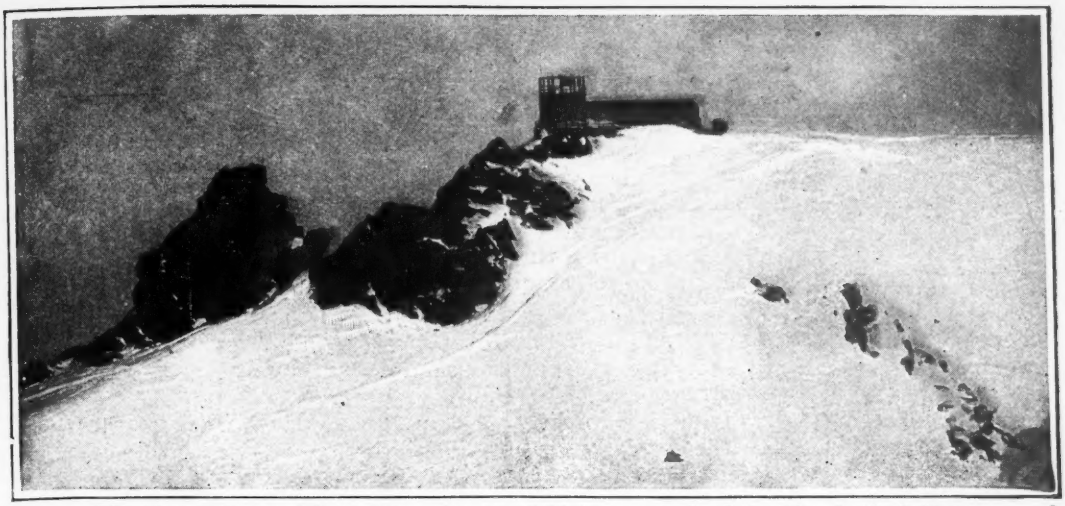
Beef, fresh eggs, bananas, potatoes and wheat have been eliminated from the food list and the animals have to subsist on substitutes. Chinese pickled eggs are used instead of fresh eggs, and bread for the monkeys is made from flour rejected by the Board of Trade. Occasionally fish is doled out, but it is only such as has been pronounced unfit for human consumption.

And Now It's the Electric Manicurist to Keep Your Nails in Order

JOHN W. RUGGABER, of Racine, Wisconsin, thinks the electrical manicuring machine he has just invented will soon be taking its place in every home.

It is a small buffing wheel rotated by motor power. After softening up the cuticle in warm water, you simply push it back by pressing it against the edge of the rotating cushion. Then, after a judicious use of nail paste (please don't use too much, we don't like nails too highly polished), the center of the buffing wheel will shine up your nails as well as any manicurist could do it, and doubtless in much less time and at much less cost.

This rotating buffing wheel will press back the cuticle and polish your nails for you



The observatory on Monte Rosa, the second highest summit of the Alps, is the loftiest scientific establishment in the world, being nearly 15,000 feet above sea level

A Scientific Laboratory Two Miles in the Air

SINCE the closing of the little meteorological station which Harvard University once maintained at the top of El Misti, Peru, and the destruction by Alpine storms (perhaps aided by an earthquake) of Janssen's famous solar observatory at the summit of Mont Blanc, the loftiest scientific establishment in the world is probably the observatory on Monte Rosa, the second highest summit of the Alps, 14,960 feet above sea-level.

The Monte Rosa observatory is also known as the Regina Margherita Cabin. It is really an outpost of a much larger establishment, situated at a lower altitude on the same mountain (at the Col d'Olen), and both institutions are called officially the Angelo Mosso Scientific Laboratories. They are maintained by international cooperation, each cooperating country being entitled to keep one investigator at the laboratories for every 5,000 francs contributed to the joint fund.

To reach the Col d'Olen entails a ride of several hours on horseback or muleback; while the ascent to the observatory is a mountaineering feat. The higher station is habitable for only about two months in the year—from July to September.

Every summer a temporary telephone line—the highest in the world—is laid to the summit. Its construction and maintenance require great skill and courage. Many of the poles are set up in the shifting ice and snow of the glaciers.

Khaki Has Been Used for Uniforms Since 1848

WHAT is the origin of khaki? To whom are we indebted for it?

It was first adopted in British India, in 1848, by Sir Harry Burnett Lumsden, who had been asked to equip a corps of guides to collect intelligence and to conduct an English force on the northwestern frontier of India. The cloth used was a light cotton drill, as suited the climate of Hindustan, and took its name from a native term, "khaki," which means in the Urdu language, "dusty," being derived from "khak" or dust. Thus the term applied to the color of the cloth rather than to the material. Though the dictionary tells us it is pronounced kaykee by the natives, the English have given it to us as kharkee, and this is the correct pronunciation.

Having been approved, the use of the cloth spread from the guides to others in the Indian army, and it was worn in the Sepoy Mutiny of 1857 by the English troops. In the Boer War, 1899—1902, khaki was adopted in the British service for an active service uniform, and so worn by all English and colonial troops in Africa. But as cotton was not warm enough for the African highlanders, uniforms of the same kind were made of serge, and the term khaki thus included woolen as well as cotton fabrics. Because it was well fitted for the climate of Cuba and the Philippines, the United States chose khaki for the soldiers' uniforms during the Spanish-American War.

All Around A Battleship

A Landlubber's Questions — Answered by Major Frank E. Evans, U. S. Marine Corps

Major Frank E. Evans, who takes you around the battleship

And so you would like to see a battleship? Let us introduce you to Major Frank E. Evans of the U. S. Marine Corps. He will take you all around the ship and, short of actually firing the big guns, will show you everything. Don't be afraid to ask questions. The Major is used to landlubbers

LANDLUBBER—Is this the largest ship in the Navy?

MAJOR EVANS—Yes, the *Arizona* and her sister ship, the *Pennsylvania*, are the largest in commission. She is six hundred feet long, with a ninety-seven-foot beam, draws thirty feet, and displaces thirty-one thousand four hundred tons. Her speed is twenty-one knots, or twenty-four miles an hour, and her final cost thirteen million, six hundred and ninety-five thousand dollars.

LANDLUBBER—And she has the biggest guns?

MAJOR EVANS—Yes, each of her twelve fourteen-inch or turret guns weighs sixty-four tons, and is fifty-two feet long. The shell weighs fourteen hundred pounds and the powder charge three hundred and eighty pounds. It costs a little more than five hundred dollars to fire each gun, and to make it possible to fire that gun cost the government eight hundred and fifteen dollars for each pound of her broadside. The turrets are placed on the ship's center-line, with the three guns of each after turret arranged on a line above those of each forward turret. Here we have the heaviest broadside and greatest radius of fire possible. When all three guns in a turret are fired together in a salvo the two outer guns are fired simultaneously and the fraction of a second before the center gun. If all three were fired simultaneously the terrific blast would derange the flight of the shells.

LANDLUBBER — How are the turrets moved?

MAJOR EVANS—Turning engines or motors move them on rollers lying in a circular path. T. R. Timby invented the revolving turret in 1841 and Ericsson paid him five thousand dollars royalty on each turret he built.

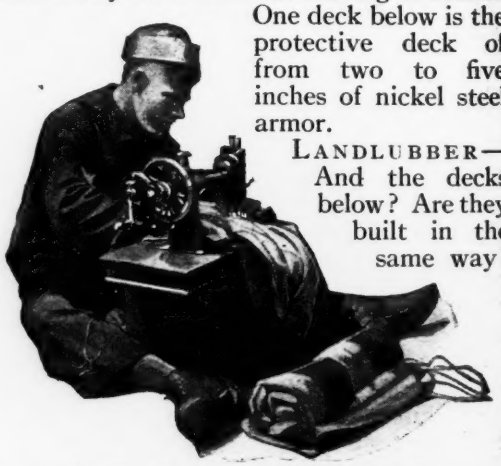
LANDLUBBER—How thick is the armor on this ship?

MAJOR EVANS—It varies from nine to eighteen inches on the triple turrets. The barbette armor is thirteen inches thick. An armor belt protecting the engines and magazines covers nearly three-quarters the length by a belt thirteen and one-half inches thick, seventeen inches from top to bottom and running half below load water line and half above. On the conning tower the sixteen-inch armored sides and the five to eight-inch armor protecting the broadside guns brings the weight of armor up to one-fourth the ship's entire weight.

LANDLUBBER—Why isn't this deck made of steel too?

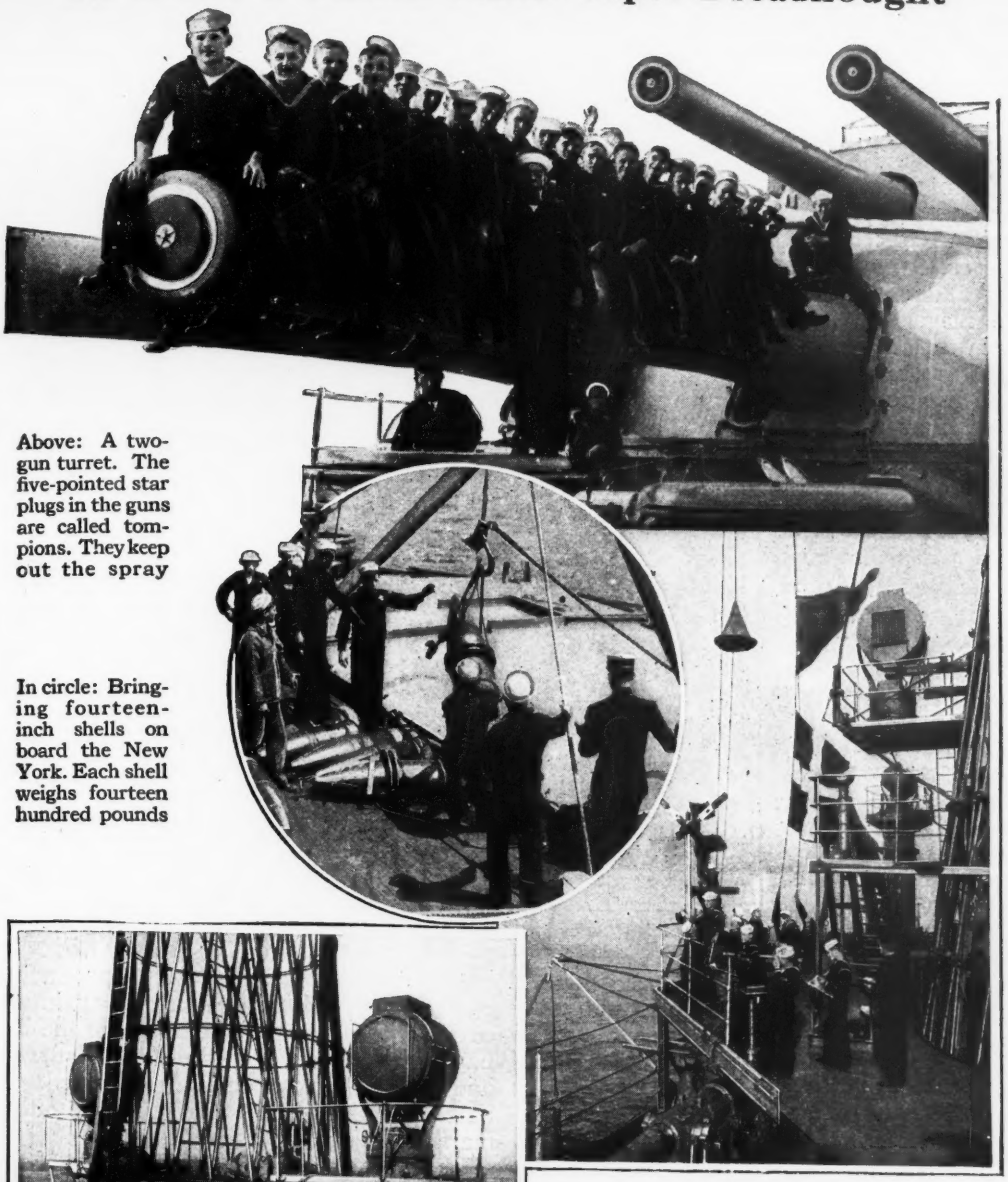
MAJOR EVANS—It is. There is steel beneath the teak covering of three and one-half inches on which you are standing. Without the wooden covering a steel deck would be unbearable in the tropics. We use teak now in place of yellow pine. It costs more but does not spread and that does away with constant calking of seams. One deck below is the protective deck of from two to five inches of nickel steel armor.

LANDLUBBER—And the decks below? Are they built in the same way?



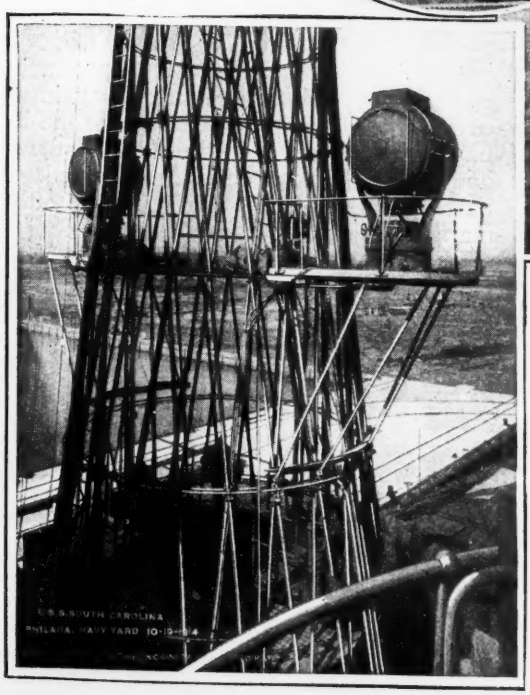
On Sunday the sailor lad finds time to do his own sewing and mending

On Board a United States Super-Dreadnought



Above: A two-gun turret. The five-pointed star plugs in the guns are called tompions. They keep out the spray

In circle: Bringing fourteen-inch shells on board the New York. Each shell weighs fourteen hundred pounds



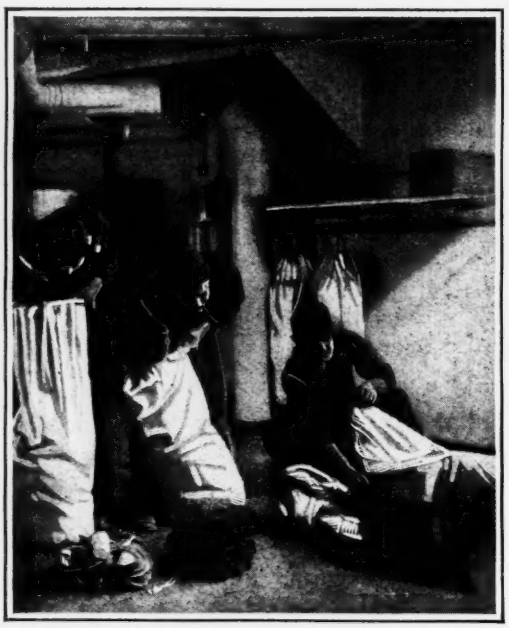
Above: Signaling on the bridge of the North Dakota. The semaphore is making the letter "U." Signalmen are wig-wagging and hauling down flags

At left: The military or fire-control mast is made of steel tubing so that one successful shot can not carry it away. Notice the searchlight platform

MAJOR EVANS—They have heavy linoleum coverings. When we go below you'll notice two curious things: rough paint on the bulkheads and magazines and gaily striped bands on piping wherever we go.

LANDLUBBER—What's the reason?

MAJOR EVANS—The rough paint is broken cork mixed in a sticky paint. The cork prevents the steel from "sweating" and helps keep the magazines and ammunition passages at a more normal temperature. The piping has the colored bands so that the leads of the piping can be followed to expedite repairs. Steam has a black and white band, salt-water green and black; fresh water is lead and black; and ventilation piping has yellow and black.



The sailor's private wardrobe is a canvas bag which is cleaned and inspected every few days

LANDLUBBER—What are those plugs in the ends of the guns with the five-pointed stars in the center?

MAJOR EVANS—Tompions. They keep spray from dashing into the muzzles and rusting the bores.

LANDLUBBER—What other guns does she carry?

MAJOR EVANS—Twenty five-inch guns on the broadsides for defense against torpedo attacks at night; four semi-automatic three-inch anti-aircraft or "sky" guns mounted on special platforms; four six-pounder saluting guns amidships and three-inch field pieces for landing purposes.

There are only three kinds of guns in the Navy: the turret guns running from eight to fourteen inches; the intermediates running from four to seven inches; and the smalier or secondary guns running from three inches down to automatics that fire rifle ammunition.

LANDLUBBER—How many officers and men would be on board in a battle?

MAJOR EVANS—In round numbers, one thousand, of whom about forty would be officers. A flagship would have ten or twelve more officers. Each ship has its captain, executive, gunnery, navigating, engineer, first lieutenant, medical, pay and marine officers. Most of these have one or more assistants. The size of the crew is based on the number needed to fight, navigate, keep the ship at full speed through a protracted battle, feed the crew, attend the wounded, fight fires, make repairs and keep the fire control and communications going.

LANDLUBBER—When a ship goes into battle does she carry her boats to take off the crew in case she is sunk?

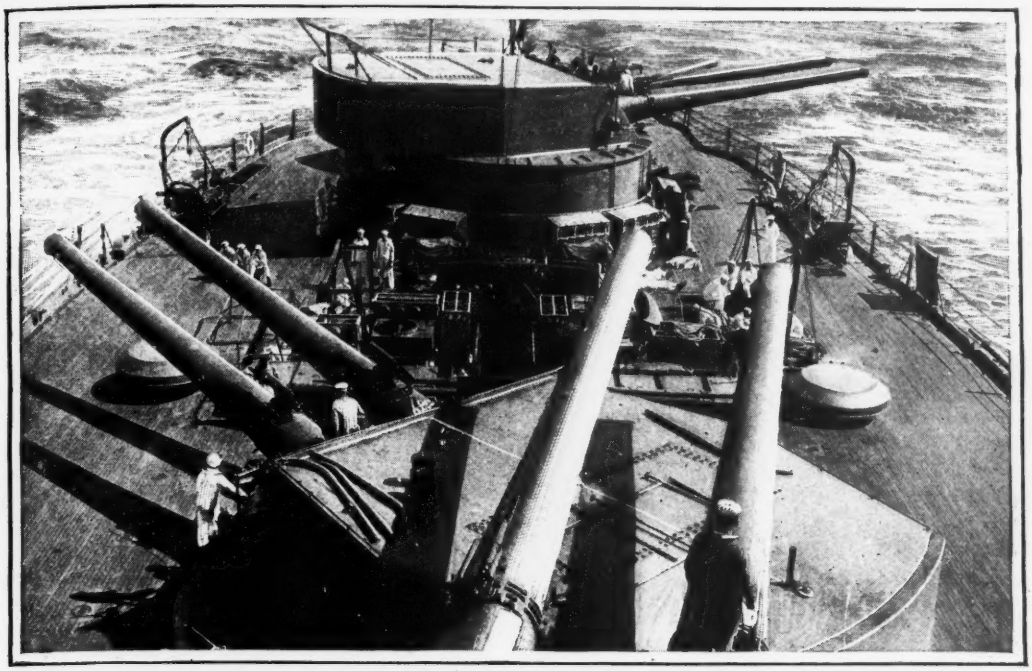
MAJOR EVANS—When a ship leaves port for impending battle she is stripped of most of her boats. The ones left on board are stowed on deck and lashed with canvas to keep down splinters. All wooden gear except the mess tables and benches are removed, and they go overboard before the fighting begins. All inflammable or splinter-producing equipment is either stored ashore or thrown overboard except the mattresses of the sick bay. Stanchions and davits are stowed, and the life lines on deck are removed. In battle practice all these articles are either marked "store" or "overboard."

LANDLUBBER—But what becomes of the crew with so few boats available?

MAJOR EVANS—If the ship sinks they trust to life preservers, wreckage and rescue by other ships. Otherwise it's Davy Jones' locker.

LANDLUBBER—Where does the crew live?

MAJOR EVANS—On the two decks below. The compartment in which a man slings his hammock is his home. Here he keeps his sea bag, ditty-box, and rifle. He eats there and is stationed at the compartment's gun. When not at mess the tables and benches are slung up above. The Government supplies an excellent ration, and the officers pay for all their food and other supplies.



The turrets are rotated by turning engines or motors which move them on rollers lying in a circular path. The revolving turret was invented in 1841

Some ships have electrical galleys in which the cooking, dishwashing, paring of potatoes and practically all work is done by electricity. The chief cook is an expert electrician. On the Arizona they find oil-burning galleys more economical.

LANDLUBBER—What advantages has the oil-fuel ships over the coal-burning?

MAJOR EVANS—The space formerly required for coal bunkers is now available for greater crew space. The oil-burners are more flexible of control in increasing or reducing speed and are practically smokeless. The crew is free from the bugbear of coaling ship. This ship carries twenty-three hundred tons of oil fuel.

LANDLUBBER—You mentioned the marines. What do they do?

MAJOR EVANS—Originally marines were employed aboard men-of-war to put down mutinies. Today their duties are almost identical with those of the bluejacket's. For all landing parties the marines, being trained soldiers as well, "hit the beach" first. In battle they man the torpedo defense guns, help supply ammunition to the turret guns and do other duties. Those not with the fleet either guard our Navy yards or are held in battalions or regiments for expeditionary service. Each battleship has a captain and lieutenant of marines and accommodates about seventy-five marines.

LANDLUBBER—I hope you don't mind my asking why the trousers of a sailor flare out so at the bottom.

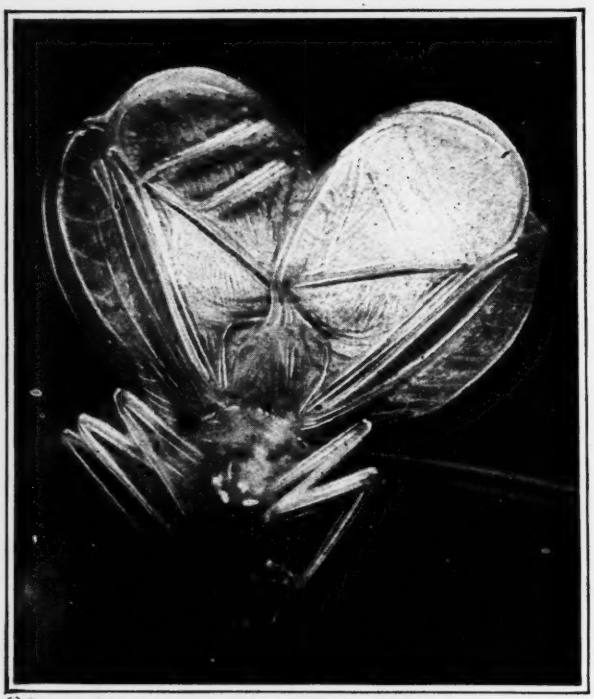
MAJOR EVANS—That's a sensible query. With the "bell" or "spring" bottom he can easily roll his trousers above his knees when washing decks. The three narrow white stripes on his collar are inherited from the stripes worn by the British bluejacket in commemoration of Nelson's three great sea victories. The black kerchief is supposed to have been first worn as mourning at Nelson's death.

LANDLUBBER—Where is the captain stationed in battle?

MAJOR EVANS—The conning tower is his battle station. A complete steering and communication system is contained in its 16-inch walls, and armored tubes also connect it with the protective deck to prevent these systems from being crippled in action.

LANDLUBBER—What do you call this mast that looks like a waste basket upside down?

MAJOR EVANS—The military or fire-control mast. It is made of steel tubing so that one successful shot cannot carry it away like the old solid mast. It carries the fire control communications and signals, and the wireless.



© Brown and Dawson

The tree cricket makes its music by rasping its wings one over the other about seventy times a minute

tures, everybody exclaims in surprise, "Why, that is something I never saw before; I never knew there was such a thing in existence. Is it a new pest? Is it something to be dreaded?"

Instead of something to be dreaded it is one of the nature lover's delights. Such singing insects seem to fit harmoniously into a summer night, and when one's temperament becomes attuned to the sounds there is no more charming, natural music in the world. The Japanese have the right point of view. They hold tea parties in the fields, and between their sips of tea and bits of conversation they listen to the calls and songs of such insects.

Every student of insects knows that the term "singing" is used figuratively. It might be more truly described as fiddling because it is made by rasping one wing over the other in a rapid movement. This is well shown in the accompanying illustration.

The Incessant Night Song of the Snowy Tree Cricket

FROM early summer to the time of frost, we hear a cheery, insistent night song that everybody knows. But only persistent and careful students become familiar with the insect that trills the song. From the grasses, trees and shrubs comes this incessant music, represented by Vernon L. Kellogg in the letters: "T-r-r—r-e-e; t-r-r—r-e-e." This is repeated about seventy times a minute without pause or variation.

Whenever a persistent student of insects obtains one of these singing, or rather fiddling crea-

The Soldiers of New Guinea Do Not Dress in Khaki

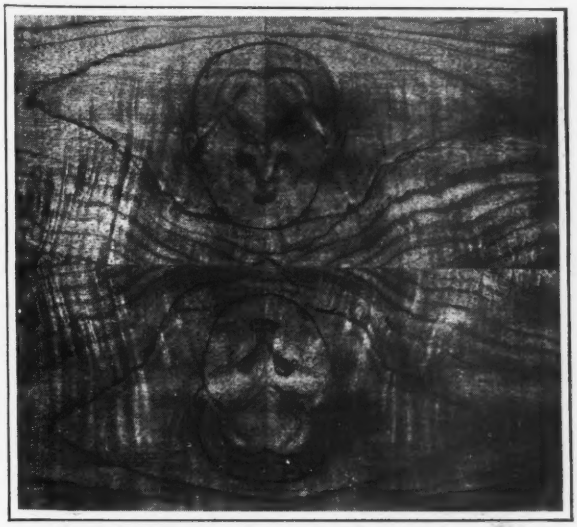
The dress of the natives of New Guinea consists principally of broad stripes of white paint and necklaces of small bones

THE natives of New Guinea are still classed as savages, although many of them have comfortable homes, clustered into villages.

The dress of the males consists mainly of necklaces made of human and pigs' bones. The warriors make themselves fierce with broad dashes of white paint on their bronze bodies and on their clubs. The bracelets below the knees of the warrior on the right of the accompanying photograph are strung with pigs' bones, probably used as amulets, since the pig is much beloved.

Some of Our Lake Waters Are Noted for Their Chemical Wealth

THERE are several lakes in the United States which contain sodium carbonate, borax, potash and common table salt. The longer the war continues the more valuable these chemical bodies become. Perhaps the best known of these is Great Salt Lake, Utah's ocean of salt. Others are Searles Lake, Owens Lake and Mono Lake, all in California. The origin of these lakes is doubtful. In some cases they are probably due to an arm of the ocean becoming landlocked. The most remarkable feature about them is the fact that they seem to be continuously fed from subterranean sources, since they maintain a uniform amount of salt.



Two freak faces executed by the world's most original and diverting artist—Mother Nature

California Has the Latest Thing in Tree-Trimming Ladders

A WEIRD-LOOKING tree-trimming ladder has made its appearance in Pasadena, California. When fully extended it is thirty feet high. From this height the tree-trimmer is able to cut off branches that are ten feet higher by means of his tree-trimming snips. In the illustration he is shown on the fifth rung from the top, cutting off the unsightly twigs. He could climb to the top rung of the ladder without overturning it. The apparatus is collapsible and when folded up it can be wheeled from tree to tree or from job to job. For transportation from one town to another the push-cart end of the device is fastened to an automobile or wagon, and the ladder is towed along with ease. There are few tree-tops, even in California, which it cannot reach. W. L. Geimer is the inventor.

The tree-trimming ladder is collapsible. It is thirty feet high

Lo, the Poor Furniture Man—He Sees Faces in Walnut

MOTHER NATURE has tried her hand at making faces. She chose the walnut veneer of Indiana and this is the result—two faces which may be likened to anything from saints to devils. The fact that they are part of the walnut markings of the wood, fresh from the outdoor workshop, is what makes them unique. Of course an experienced painter could have made better looking faces than these on any kind of wood. But he couldn't make them so you couldn't wash or rub them off. The faces which Mother Nature has put into this walnut wood are there to stay, safe against even sandpaper and plane. Walnut veneer is generally used as an ornamental facing for inferior grades of wood. There are some people who could point with pride to faces in their dining tables, calling them lost Rubens cherubs.

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The force of the outrushing water turns the ten nozzles round

A Fire-Hose with Ten Nozzles. It's to Be Used in Ships' Holds

"FIRE in the hold!" Since the first freighter sailed the seas, there never has been a warning more to be dreaded. A fierce fire cannot be smothered. There is nothing to be done but to take down the hose and face the music. In an effort to improve on the old and dangerous method of groping about in the dark and the smoke to locate the seat of the fire, Fire Chief Heffernen, of New York, has been testing out a novel system. He has been using a multiple nozzle which floods the hold in every direction. An entire cargo may thus be damaged, but after all, that is better than suffocating the firemen.

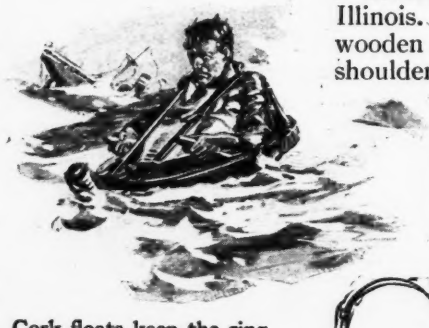
Not one, but ten ordinary nozzles terminate at the end of a great hose. When they are lowered into the hatchway and the emergency engines pump away at full load, ten great water streams rush equally out of each nozzle. In doing so, the nozzle mounting is turned around, so that no part of the hold is left untouched over a circular area a hundred feet in diameter. About 16,000 gallons of water are pumped each minute.

A Spring-Motor for the Human Jaw

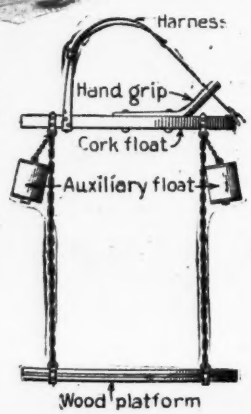
A YOUNG girl was admitted recently to a New York Hospital. She had a form of lockjaw. The surgeons removed the muscles of the lower jawbone and substituted a device with a spring to be wound up just as one would wind up a clock. The device was fastened to the jaw and extended over the head. The spring kept the jaw in constant motion. After about three weeks, the device was removed. The muscles of the lower jaw had developed wonderfully. The girl was then put to chewing gum.

The Story of a Life-Saving Platform —And How It Will Not Work!

SINCE Germany began her submarine warfare, the number of applications for patents of life-saving apparatus has increased a dozenfold. Some of these have at least been reasonable, but most of them have been grotesque. Take, for instance, a device invented by a citizen of Illinois. A man stands upon a wooden platform and straps to his shoulder a buoyant ring from which the platform is to be suspended when in the water. Unfortunately, however, no instructions are given in the patent copy which would tell the man how he could jump away from the sinking ship. If a person is to stand upon the platform, how is he to use his feet to jump?



Cork floats keep the ring and platform afloat. At right: Detail of the device



Even if a man could land in just the proper position in the water, this device, it seems to us, would be no better than the ordinary cork life-preservers.

A Waving Flag in Badge Form for Your Buttonhole

ONE of the novelties brought out by the war is a figure of Uncle Sam waving a small American flag above his top-hat. Owing to the construction of the badge, the flag actually moves, as in waving, at the slightest motion of the wearer. The badge consists of a metal figure of Uncle Sam, with the flag at the end of an upraised arm, which isn't an arm at all but a flexible spring fastened to the top of the shoulder of the figure, as the accompanying illustration shows. Each time the wearer of the flag moves, the spring jumps up and down and sideways, giving the flag a waving motion. By means of a stick pin on the back, the badge may be readily attached to the hat, coat, dress front, or even the neck-tie, wherever it is preferred.

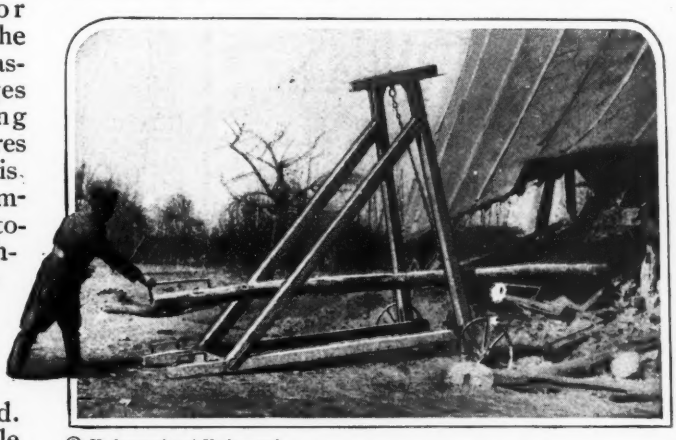
The flag is attached to a flexible-spring arm, as shown at the right

Demolishing French Cottages with a Battering Ram

THE Germans have left behind them another tool of destruction during their so-called victorious retreat to the Hindenburg and Wotan lines. It is a battering ram such as Helen of Troy might have looked down upon from her father's watchtower. But the Germans did not use it for destroying walls round fortified cities, as did the warring ancients. They used it for smashing in the sides of peasants' cottages and reducing those structures to piles of debris.

In the accompanying photograph a Frenchman is illustrating for civilization just how the ram was operated. A heavy pole of sturdy wood is suspended by means of a chain from a scaffolding on wheels. The chain is attached to the ram at a point which will enable the operator to pick up the other end without much effort.

That the ram is effective as a destructive agent is manifest in the photograph. The side of the peasant's cottage which lies in ruins was evidently of brick or masonry before the Germans decided to ram it to pieces. All that now remains of it is a few tottering beams supporting a twisted and warped roof. The two wheels in front of the apparatus and the wire handles on the bottom pieces make the apparatus a portable one. It was probably moved from place to place as the Germans retreated through a devastated and shell-torn country to the more formidable positions in the rear.



© Underwood and Underwood

How the retreating Germans wrecked peasants' cottages with an old-fashioned wooden battering ram

What Six Gallons of Good Gasoline Can Do

FEW persons have any conception of the immense amount of energy that is stored in the natural oil products in everyday usage. Take, for instance, the gasoline that is used in automobiles day by day. The motorist will be interested to know that if the same amount of energy that is used up in "autoing" a hundred miles were employed to milk cows, some ten thousand gallons of the milk could be obtained! Or, if the same energy were used in patriotic gardening, fully four acres of ground could be plowed. That amount of energy could also mix up eighteen hundred cubic feet of the thickest cement.

The kit preserves the shape of cigars, holds pipes upright and provides a space for the storage of tobacco

This Smoker's Kit Is Approved by the Neat Housekeeper

SMOKING makes a contented man, it is said. On the other hand, smoking, if the pleasure be derived from pipes, is likely to make a very discontented housekeeper. For pipes have a careless way of spilling their ashy contents on tables if they are thoughtlessly placed on them. Joseph F. Jeckert, of Garfield, New Jersey, is therefore to be commended for his smoker's kit. It not only keeps pipe ashes where they belong, but there are compartments for cigars, tobacco and matches in the same kit.

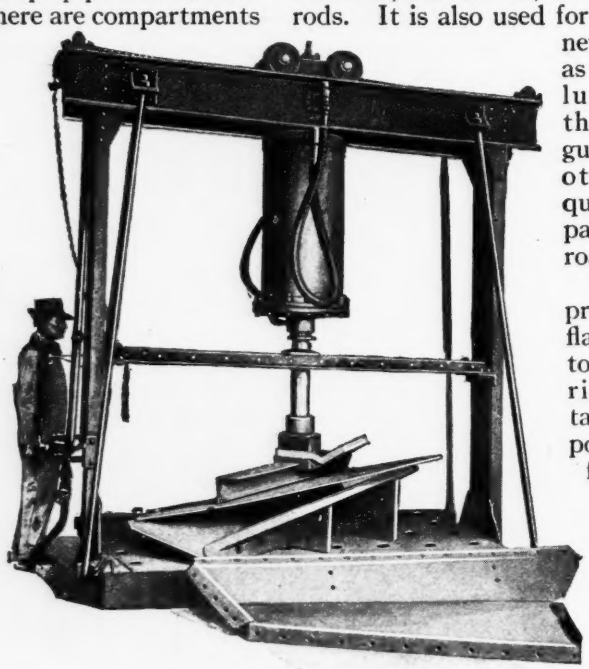
The kit may be hung on a wall or placed on a table as it appears in the photograph. The pipes are held in an upright position and if there are loose ashes they will fall out into the tray. Furthermore, the nicotin and other juices will run down the stems and into the bowls. A corrugated panel furnishes the upright channels to hold the pipes.

Why Young Pheasants Require Foster-Mothers

IN pheasant-raising the greatest difficulty is to secure "setters." Says L. S. Crandall in *Pets*, (Henry Holt & Co., New York), "If the female (pheasant) will incubate, she can not be excelled for rearing the young, but in most cases she refuses to perform this function. It is customary, therefore, to remove the eggs and place them under a domestic hen. For this purpose a small bird should be chosen, preferably a Silkie, or a gentle little Bantam.

A Novel Machine for Reclaiming Scrap Materials

HERE is a machine which is interesting because of the many uses to which it can be put. It can be applied to general manufacturing and repair shop work where bent sheets and structural members have to be straightened or where it is desired to form new material to particular shapes. It is a press particularly adapted to the straightening of bent railway truck-frames, center and side sills, side sheets, channels and truss rods. It is also used for the forming of new hopper sheets, as shown in the illustration, and the bending of guard rails and other work required by way departments of railroads.

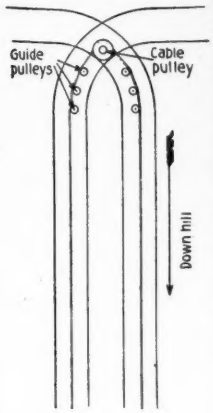


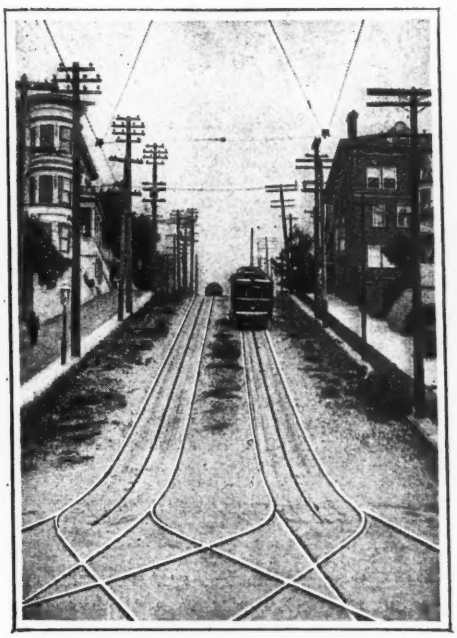
The pressure cylinder is suspended from a four-wheel carriage propelled by an endless chain

The base of the press is a heavy flat steel casting, to which two uprights are attached, which support a main cross-frame. Two channel sections placed back to back, constitute this cross-frame and serve as a track.

Street-Cars Pull Each Other Up Hill in San Francisco

IN one of the residential sections of San Francisco is a hill so steep that an ordinary trolley car can not climb it. The chief engineer adopted a principle made familiar by many mountain railways. A channel was cut between the rails of each track from the base of the hill to the summit. In each channel was placed a heavy steel cable, which travels over a huge pulley at a point where the two tracks meet and become one at the summit.





Too steep for cars to climb. The diagram shows how one car pulls the other up

The car at the top of the hill and the car at the bottom each pick up the cable. The car at the top of the hill is permitted to run under its own power down the slope, thus furnishing the energy necessary to pull the other car up the hill on the opposite track. Compressed air is used to retard the cars when necessary and to prevent a runaway should a cable break, which is not probable.

The solving of this problem has placed at the disposal of homeseekers a delightful section of the city for residences.

This Device Won't Let Your Hat Blow Off

NEW hats have a way of blowing off their owners' heads largely because no two heads are shaped exactly alike, and until the hat has been worn long enough to conform to its owner's head it will not fit properly.

A simple device has been invented to make any hat conform to the wearer's head. It is an open-ended tube of cloth made of a single strip of material. The tube contains a strip of spring-steel, one end of which is doubled back while the opposite end extends beyond the cloth tube. When the device is in use this is inserted in the other end of the tube, thus closing the conformer in the hat.

The metal strip has needle-like projections which are stuck through the cloth tube. These serve to keep the cloth attached to the metal strip and may be pushed through the hat crown to keep the device in place. The finishing touch is an elastic cord which is used to tie the ends of the tube together.

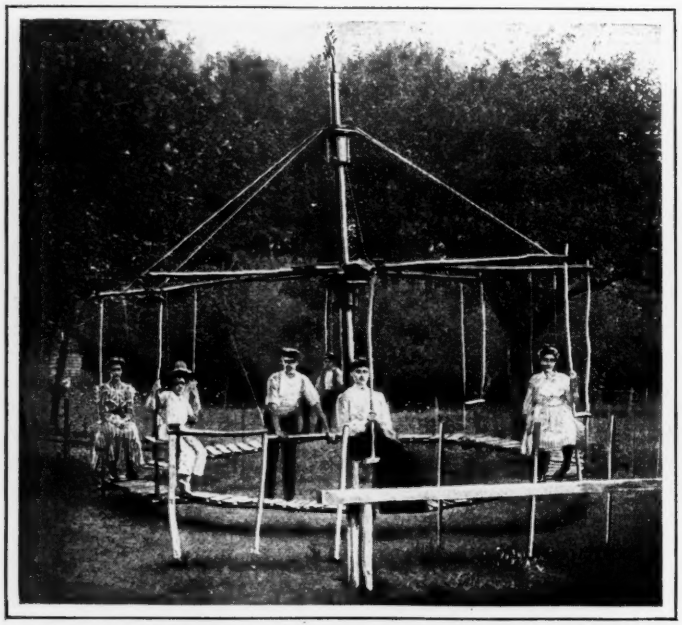
By means of this cord the hat is made adjustable to fit the head even when the wearer has just received an inordinate amount of unexpected praise. Its elasticity will take care of any ordinary expansion, but it may be untied and loosened up on special occasions.

A hat so equipped will be as stationary on the motorist's head as the approved peaked cap and equally as defiant of the wind.

A simple device which may be attached to any hat to make it conform closely to the shape of the wearer's head

Making an Amusement Park Out of a Vacant Lot

TWO boys of South Andover, Mass., with some mechanical skill, recently found that a shaded lot can be converted into an amusement park at a cost of about fifty cents, the only purchases necessary being some nails and a few packing boxes for the merry-go-round. With these and some oak saplings, which were cut down in nearby woods, they constructed a crude but highly satisfactory carousel which soon covered the cost of construction and brought in clear profits for the entire summer.



The proprietors of the homemade merry-go-round charged one cent a ride for children and adults and made money

The oak saplings formed the arms of the supporting framework. They were eight in number and eight feet long. Eight being the magic number, accommodations were provided for eight persons, regardless of weight, and eight minutes was the duration of the ride. The motive power was furnished by the promoters of the idea, who took turns pushing on a bar attached to the central support.

According to the juvenile patrons of the improvised amusement park, the only thing lacking was the music, without which a merry-go-round loses much of its thrill. When a whistling quartette and a harmonica failed to meet the demand of the patrons, the promotors found that their savings for this first season would have to be invested in a phonograph or hand-organ in order to double the proceeds next year.

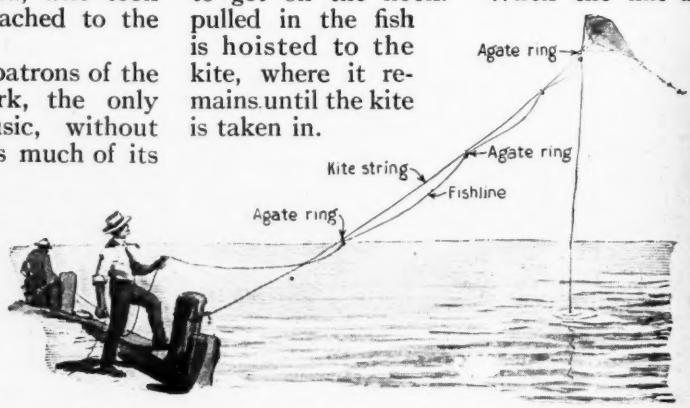
He Hitches His Fishing Line to a Five-Foot Kite

FISHING for Corbina with kites to carry the fish lines into deep water is the innovation in angling recently inaugurated by Thomas McD. Potter, of the Los Angeles motorcycle club at Seal Beach.

At Seal Beach there is a fine Corbina "hole" just far enough from the pier to be out of the reach of the best casters. Boats, of course, could be used, but they cost more than kites, are conducive of seasickness, and don't offer half the sport that kite fishing does.

Potter does his fishing as illustrated in the drawing below. Better sport cannot be imagined, while from the mechanical point of view the method is quite as satisfactory as it is original.

The kite used is about five feet high, which is big enough to have sufficient "lift" for almost any fish that chances to get on the hook. When the line is pulled in the fish is hoisted to the kite, where it remains until the kite is taken in.



When a fish gets on the hook the kite bobs up and down. A quick pull on the line raises the fish to the kite

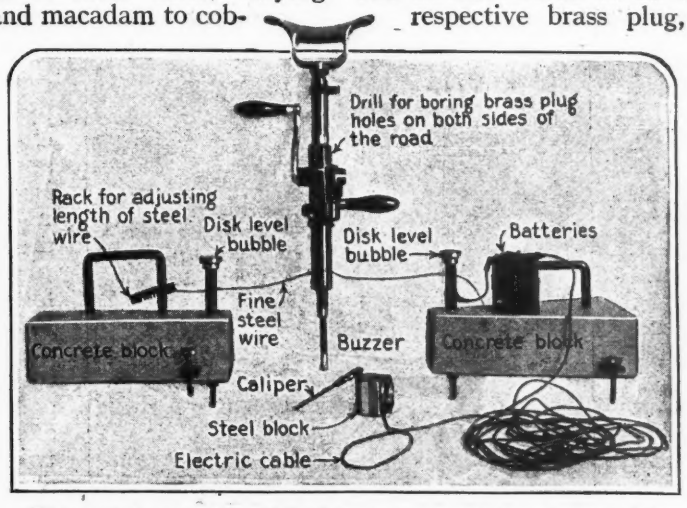
Measuring the Wear of Roads

A means by which the right material for the right place is determined

THERE are now approximately two million, three hundred thousand miles of public roads in the United States, not including the streets of our incorporated towns and cities. The materials which are used in them differ, varying from concrete and macadam to cobble stones and dirt. The determining of the right material for the right place is a problem the solution of which would save many millions of dollars.

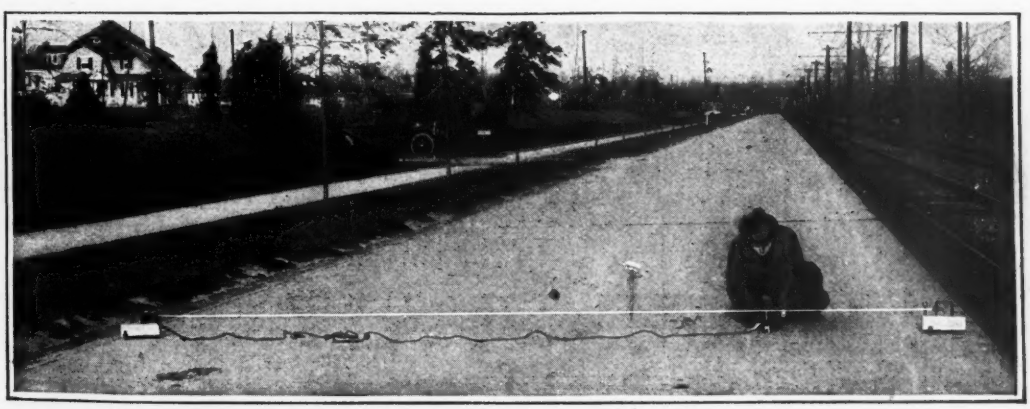
The importance of this consideration has led the Office of Public Roads and Rural Engineering to attempt to secure definite information on the wearing qualities of different materials under different conditions of traffic. For this purpose, the office has adopted a method which is very accurate.

A brass plug is permanently buried in each side of the road, three-quarters of an inch below the surface. Between these plugs a wire is stretched by means of the concrete blocks shown in the photographs. One of these blocks is pivoted on the vertical rod which passes through it in front, the weight of the block being utilized to keep the wire taut. By placing the vertical rod of each block so as to stand on its respective brass plug, and by then adjusting the length of the wire until the bubble-level shows the rod to be "plumb," the fine wire will always stretch across the road in a certain line which will notvary,however much the road may be worn down.



The equipment with which the wear on roads is measured. The concrete blocks hold the fine wire which is stretched across the road

Having established a measuring line, the rest is easy. A steel block is placed upon certain spots across the road and a caliper measures the vertical distance from it to the wire. This can be obtained very accurately because the caliper screws upward and when the top of it just touches the wire, an electric circuit is closed and a buzzer rings. Repeating this measurement reveals the amount of wear.



A fine wire is stretched across the road. By noting the differences in distance between it and the road at intervals of time the rate of wear of the road is readily determined

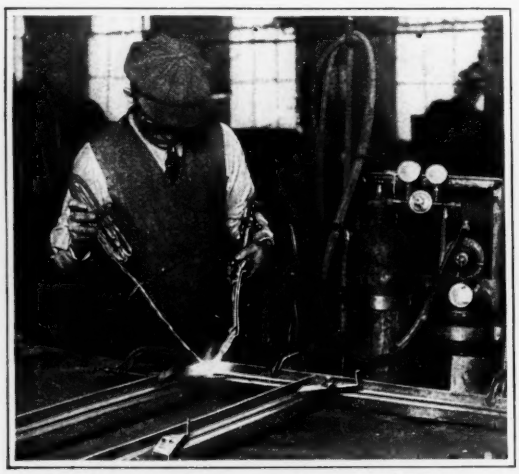
The Hottest Heat

The highest temperature ever reached by man is 9400° Fahrenheit

By Raymond Francis Yates

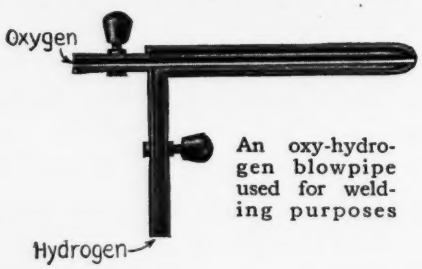
UNTIL late years the greatest heat man possessed as an industrial agency was that of the ordinary fuel furnace in which temperatures approaching thirty-two hundred degrees Fahrenheit were possible. While these temperatures were indispensable and important utilities of industry at the time, they are insignificant today in comparison with the heat employed in the commercial production of rubies, calcium carbide, carborundum, graphite, and steel.

The two great allies of man today in the production of heat are, in order of their importance, chemistry and electricity.



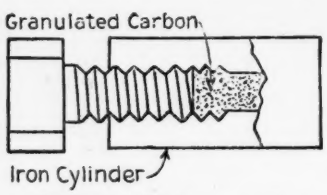
Workman welding a broken steel frame with heat from an oxy-acetylene blowpipe

A gas composed of mixed hydrogen and oxygen when ignited burns so furiously that it produces a temperature of thirty-six hundred degrees Fahrenheit. Utilizing the combustion of these two gases as a source of heat, a Frenchman, M. Verneuil, has commercially produced rubies, by fusing alumina with a trace of chromium oxide as the coloring medium. So perfect is this imitation gem that it is chemically impossible to distinguish it from the natural article.



An oxy-hydrogen blowpipe used for welding purposes

The oxy-hydrogen blowpipe is also used for welding. The temperature of the flame is just beyond the melting point of quartz, and by its use, tubes, flasks and many different pieces of quartz chemical apparatus are constructed. Quartz vessels are invaluable in chemistry. They resist most acids and rapid changes in temperature.



Professor Moissan made wonderful imitation diamonds with this apparatus

The Wonderful Thermit Process

The next step in realizing high temperatures by means of rapid chemical action was discovered by Professor H. Goldschmidt, of Essen, Germany. This is called the "thermit" process, and it produces a temperature as high as thirty-four hundred degrees Fahrenheit. A furious heat is produced by thermit because of the great chemical affinity existing between oxygen and aluminum. If granulated iron oxide and aluminum are mixed together and properly ignited, the iron rapidly loses its oxygen to the aluminum according to the following simple equation:

Aluminum+iron oxide=
Aluminum oxide+iron

After the reaction has been completed, the iron will be found in a molten state just beyond its boiling point. The oxides of many other elements act in the same manner. This makes the thermit process a very valuable asset to the metallurgist and chemist.

Not only has thermit proved itself an ally of the metallurgist, but of the engineer and mechanic as well. It has been found that if a small amount of titanium is placed in thermit, it forms an alloy with the molten iron which makes it invaluable for welding purposes. A few years ago, a fractured casting, no matter

now costly, had to be relegated to the junk heap. Today, it can be repaired easily and perfectly by the use of thermit with a trifling expenditure. In the photograph below will be seen the thermit process in operation at the Brooklyn Navy Yard.

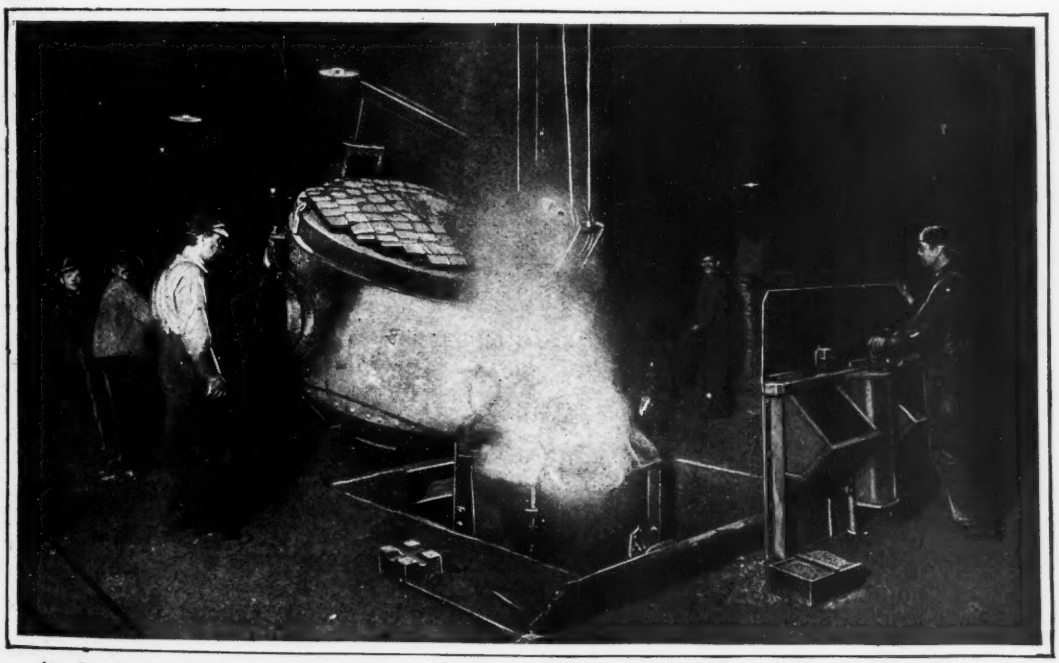
Greater even than the heat of thermit in the temperature scale is that attained with the flame formed by the combustion of the gases, oxygen and acetylene, in the proportion of 1.7 volumes of the former and 1 volume of the latter. In the apex of the cone of a flame so produced, a temperature of sixty-three hundred degrees Fahrenheit is realized. The hydrogen, which is freed from the acetylene, surrounds the flame and prevents a loss of heat and confines it to a small space. By a suitably constructed blowpipe, this little flame is used to great advantage even by a comparatively unskilled workman for the quick repair of small, broken castings where the use of thermit would be impractical.

To go further in the explanation of methods for attaining high temperatures, we must introduce electricity—the greatest heat-creating power that science commands.

Using the electric arc to weld together the parts of a large motor armature

What the Electric Arc Has Done

For those who are not familiar with the theory of the electric arc, a brief explanation of its operation will be given. If two carbon rods, maintained at a sufficiently high difference in voltage, are made to touch and then quickly withdrawn, an arc will be formed. When the rods are brought into contact, a spark is produced hot enough to vaporize a small portion of carbon, which fills the gap with carbon vapor. The carbon vapor thus liberated reduces the electrical resistance of the gap from many thousand ohms to a few hundred.

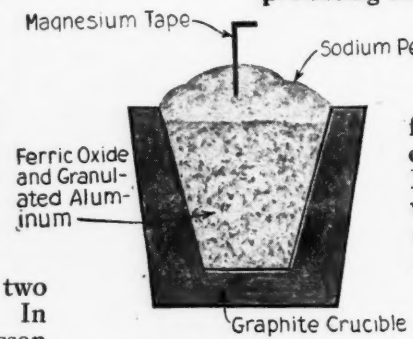


An electric furnace of the arc type pouring out part of its three-ton charge of molten steel, which has reached a temperature of 3600° Fahrenheit through the affinity between oxygen and aluminum

The current then uses the path of vaporous carbon as a conducting medium and heats it to a great temperature. The greater the current intensity used, the greater will be the resulting heat produced.

Making Diamonds at Home

The furnace with which Moissan, pioneer user of the electric arc, conducted startling experiments and made many discoveries, is most simple. It consists principally of an arc drawn between two large carbon electrodes and supplied with a very heavy current. The arc is enclosed in the cavity formed by two large limestone blocks. In this simple furnace Moissan produced a temperature of sixty-three hundred degrees Fahrenheit and, had it not been for the fact that carbon boils at this temperature, we can not predict how much further the temperature could have been carried.



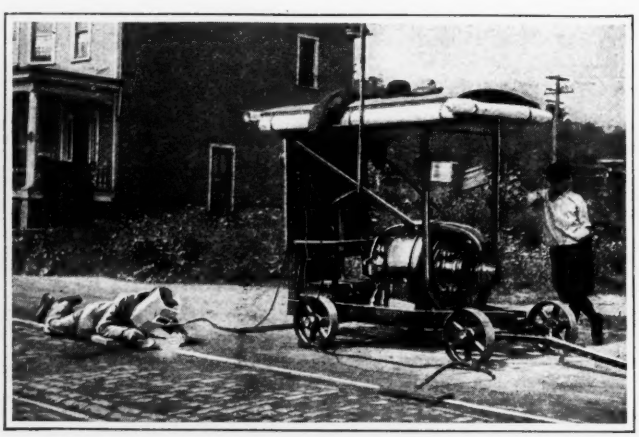
The essential elements which are used in preparing thermit for the laboratory

With the aid of his electric furnace Moissan made as many as one hundred and fifty valuable contributions to science. Among his more notable discoveries was the production of the carbides of nearly every metallic element and the artificial creation of the diamond which is crystallized carbon.

The science of electrothermics has developed many new industries and substances, not only through the efforts of Professor Moissan, but many other investigators as well. Nor have all the industries founded made use of the arc in their furnaces. Many, such as Acheson's for the production of carborundum and graphite, are of a different type. In Acheson's furnace the substances to be converted form a part of an electrical circuit and offer such resistance that temperatures as high as sixty-three hundred degrees Fahrenheit have been produced.

It was by means of the electric furnace that Hall made aluminum a commercial article. Before his time it was a laboratory curiosity. Taylor produced carbon-disulphide and Willson developed a means of producing calcium carbide on a commercial scale.

The highest temperature ever reached by man was produced a few years ago by two English experimenters, Sir Andrew Noble and Sir F. Abel. This was done by an explosive called cordite, which is a form of smokeless powder composed chiefly of guncotton, nitroglycerine and mineral jelly. When this was exploded in a durable steel cylinder, a temperature of ninety-four hundred degrees Fahrenheit was produced. This was due to the suddenness of the reaction, and, although of momentary duration, it was an interesting scientific achievement nevertheless. With the aid of cordite, Sir William Crookes was able to make small diamonds.



Using the intense heat of the electric arc in welding street-car rails. Note the head gear worn by the man

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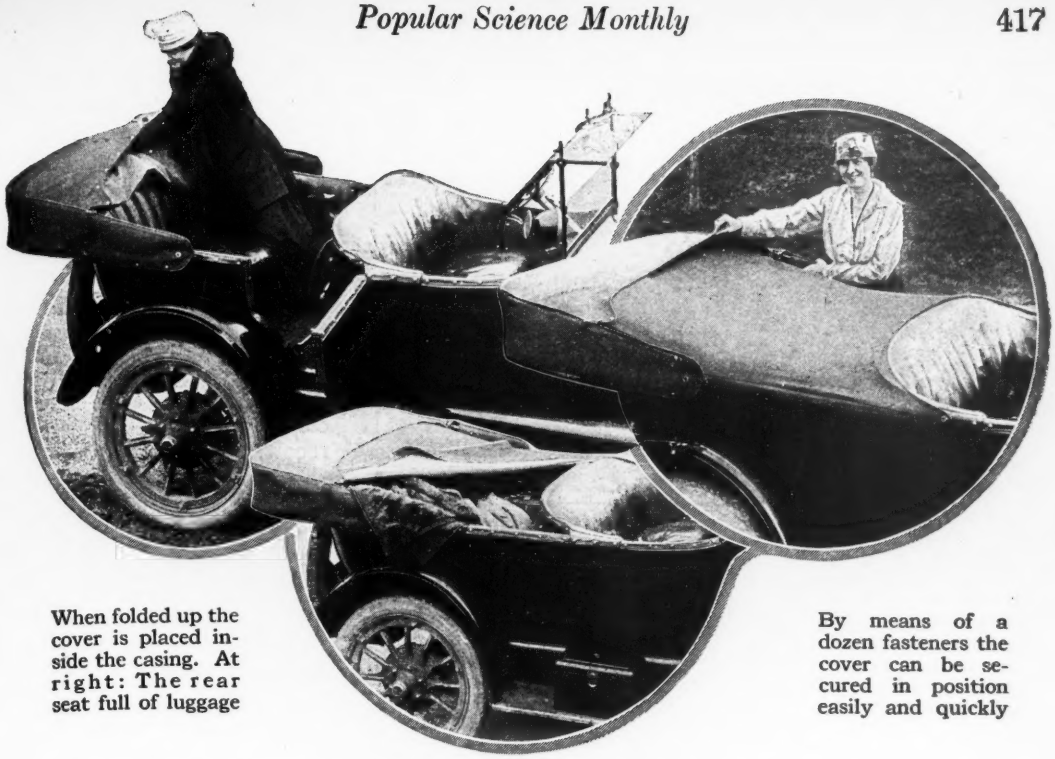
Doff Your Hat to the Goat—Its Milk Saves Babies' Lives

CHEMICAL studies made recently at the Agricultural Experiment Station at Geneva, N. Y., to ascertain the value of goats' milk as a substitute for cows' milk showed marked differences between the two kinds of milk but could reveal no reason why "Goats' milk agrees better with babies than does cows' milk," the fact that it does so being unquestioned. The Station maintains a herd of goats in order that the investigations may be carried out under the best conditions.



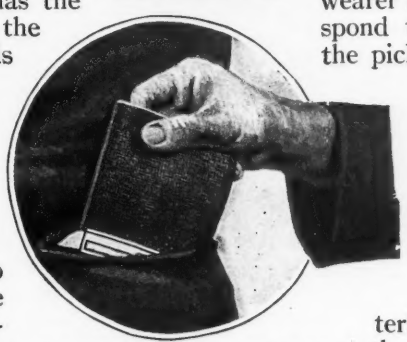
When folded up the cover is placed inside the casing. At right: The rear seat full of luggage

By means of a dozen fasteners the cover can be secured in position easily and quickly

A Dust-Proof Cover to Keep the Automobile Luggage Clean

THE luggage which you are carrying in the rear seat of your automobile need not be exposed to dust and rain if you use a cover recently designed by Arthur Paulson, of New York city. It is inexpensive and convenient. When stretched over the rear of the car, covering the entire rear seat and the floor space in front of it, as one of the accompanying illustrations shows, it will protect everything that you carry from the dust of the road.

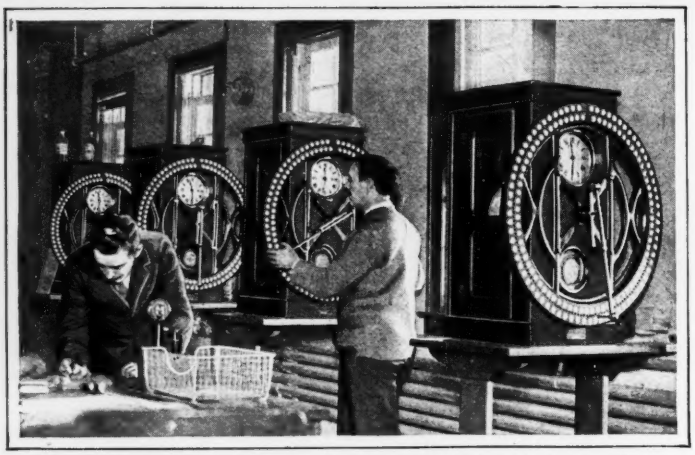
The cover consists of leather or rubberized canvas which has the shape of the rear portion of the car. Ordinarily, the cover is folded and is stored away in the cloth casing which surrounds the automobile top when it is folded away in the rear. One end of it is attached by fasteners to the edge of the casing. When it is to be used, one pull will suffice to bring it out from its position under the casing. After the luggage has been placed in position on the floor and on the seat, the cover is made fast by attaching it to fasteners placed on the cover top, the doors of the automobile and the back of the front seat. In addition to keeping your luggage clean, the cover protects it from thieves.



With the safety device the folder can not fall out or be stolen

A Little "Safety First" Device for the Bill Folder

A NEW bill folder has been designed which will stick as close to you as your coat itself. It has a snug-fitting clamping device which holds it flat and fastens it to the inside of the pocket so that it will not fall out when the wearer is stooping and will not respond to the magnetic fingers of the pickpocket. When the owner himself wishes to remove the bill folder from the pocket he simply presses on the long outer bar of the clamp and releases the folder from the pressure. It then slips out easily and is as readily replaced. The device does not interfere with the comfort of the wearer when he is sitting down.



Professional time-clock punchers operate the clocks for five hundred longshoremen at the Bush Terminal, Brooklyn, N. Y.

Experts Punch the Time Clock for Slow Stevedores

EVEN in this age of specialization it is not considered necessary to hire an expert to punch your time clock, that detail being left to the worker in the average industrial or commercial plant. The operation seems simple enough. Merely swing the indicator about the dial with its circle of numbers, stop at the right number and register your time by a swift pressure of the hand.

But if a plant employs a large number of men it may be found economical to employ not one but four expert time clock punchers, operating as many instruments, and the saving of working minutes runs up into a total of days and months in a short period.

At the huge Bush Terminal in Brooklyn, N. Y., five hundred longshoremen are employed every day on the average, magnificently muscled giants well fitted for the work of juggling pig iron and sacks of coffee, but with finger tips far from delicate and perhaps a bit slow. Therefore it is about as well as they can do to punch their own time at the rate of six or seven stevedores a minute. With four clocks, that would be twenty-eight a minute at their maximum speed.

The professional time-clock punchers can handle two hundred men a minute when pressed for time, and as a rule they take the time of five hundred laborers in five minutes. This means that instead of long lines waiting at the windows, the strings of men are short and quick moving. Before each clock is an open window and above it is the sign indicating the numerals checked there, from 1 to 250; from 250 to 500, etc., for the four clocks will take care of 1,000 records. The stevedore shows his brass check or calls out his number as he reaches the window.

A Sanitary Dining Car. No Hospital Can Be Cleaner

A NEW dining car on one of the western railroads has some unique sanitary features. The kitchen is ventilated so thoroughly that dust and cinders cannot enter the car. A continuous flushing arrangement keeps the receptacle for milk and cream clean, and the fish is kept in a separate refrigerator. A fan outside the car at the rear drives out the odors. The car cost $30,000. It seats thirty-six passengers.

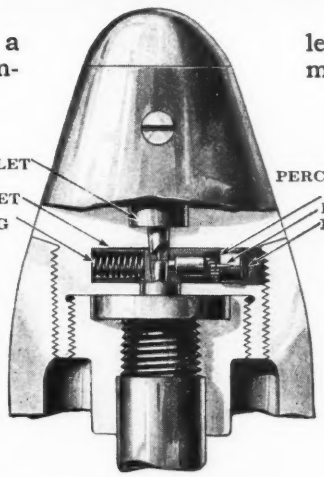
This Shrewd Little Marketwoman Is Made of Figs

A DOLL with which youngsters can be amused on rainy days, and which lends itself to a curious effect in decoration may be made from dried figs and bits of cloth from the scrap-bag. The little marketwoman shown in the accompanying illustration is a good example of the results to be obtained. The stem of the fig makes a characteristic nose. The eyes are those of an old discarded bisque doll. The mouth is a mere incision in the fig skin and the neck is another smaller fig pressed up into the head. The basket is also a fig with a worsted handle.

Dried figs are responsible for the keen expression of this very ancient Katrina of the markets

The Detonator Head

Although it explodes a giant shell it is harmless until it leaves the muzzle of a gun



The body of the detonator head carries within it a cylindrical block of material known as a graze pellet, while the cap of the head carries the percussion needle. An alternate detonating device is also provided in the body—one which becomes effective only after the graze pellet has been released by contact. This second detonating mechanism is provided simply to assure explosion and is probably seldom essential

THOSE great shell craters which form such commodious quarters for the Tommies to stretch in after weeks of confinement in narrow trenches or which may be improvised into forts on occasion, are mostly formed by the explosion of high-explosive shells fitted with detonator heads, although similar craters may also be formed by detonated shrapnel. The shattering of fortifications, the demolition of supply depots and most of the damage caused by explosive shells is made possible through the agency of the small detonator fuse or head fitted to the nose of each projectile.

This little device is simple in construction and is of interest in that two distinctly different forces are required before it will become effective—a centrifugal force for unlocking the mechanism and a detonating force for the explosion.

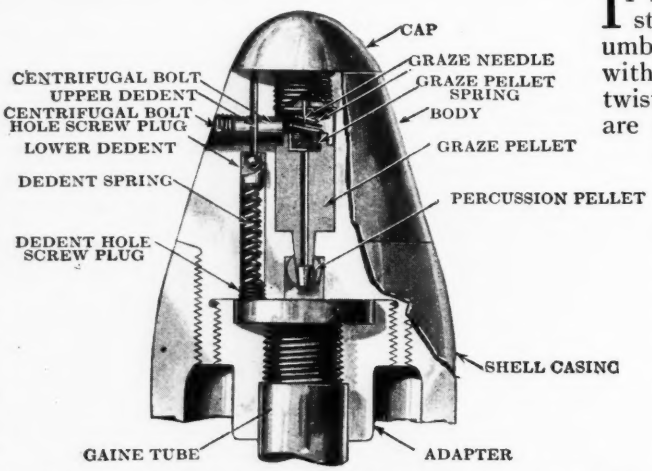
On being fired from the gun, the projectile travels at a high rotary speed and the dedent spring is compressed, so that the dedents, acting as virtually one piece, drop down into the dedent spring cavity. The twirling of the shell throws the upper dedent out of plumb as soon as it drops into the spring cavity. On the recoil of the spring the dedents lock into the larger hole. The twirling of the shell, due to the rifling of the gun, also causes the centrifugal bolt to fly away from the graze pellet once the upper dedent has dropped into the lower cavity, so that the graze pellet is held in position simply by the coiled spring between it and the cap. In the top of the graze pellet is fitted a detonator charged with a highly explosive material. On the arrest of the flight of the projectile, through contact with a solid body, the graze pellet with its detonator is thrown violently against the needle in the cap and exploded. The resulting flash passes through a central hole in the graze pellet and ignites the powder in the gaine tube and is transmitted through it to the explosive charge at the base of the shell.

Protruding from the lower end of the graze pellet is a teat which fits into a hole in a kind of transverse carriage known as the percussion pellet. This pellet carries at one end a holder containing at its center the percussion needle around which are a number of flash holes giving direct communication through the percussion pellet to the top of the gaine tube. Opposite the percussion needles carried in the body of the head is a second charged detonator. Behind the percussion pellet, or, rather, within the hole bored in its opposite end, is a spring, held in compression by the teat of the graze pellet. When the graze pellet is thrown forward by the contact of the projectile, this teat is withdrawn from the hole in the percussion pellet, releasing the percussion spring. This throws the percussion pellet forward forcibly, resulting in the contact of the percussion needle with the second detonator. The flash created is transmitted through the flash holes surrounding the needle and passes to the top of the gaine tube, thus doubly assuring ignition of the explosive charge in the shell.

This second detonating arrangement can not operate until the graze pellet has been thrown forward into contact with the graze needle, and the graze pellet cannot travel forward until the centrifugal bolt has been thrown out of place, which, in

turn, cannot happen until after the dedent spring has been compressed and the dedents dropped into the lower dedent cavity.

Notwithstanding the fact that the detonating head is capable of causing the instant explosion of the projectile, it is in reality a harmless piece of mechanism until it leaves the muzzle of the gun. In fact, a pretty heavy blow of a sledge hammer could be given this detonating head without any danger of exploding the projectile. In the illustration at the right is shown the various parts of the mechanism and their relation to each other.



The graze pellet fits loosely into the fuse body and is held in position by a small block of metal known as a centrifugal bolt which fits into a transverse hole in the body and protrudes over the shoulder of the graze pellet. Behind this centrifugal bolt and holding it in place is the upper dedent. This is a simple rod with a ball end fitted into a cup-shaped receptacle in the lower and larger dedent. Under the lower dedent is a coil spring simply stiff enough to hold the lower dedent up against the shoulder formed between the lower and upper dedent holes, at the left of the illustration above

Growing Umbrella Handles to Simulate Freaks of Nature

IT is a mistake to state that all the umbrella handles, with their kinks and twists and bends, are freaks of nature; they are, on the contrary, the result of careful training on the part of some umbrella farmer. A moment's thought and you will admit that, in all your rambles through the woods, you never saw anything like the handles on dollar umbrellas obtainable in the city.

In France there is a plantation of several hundred acres devoted entirely to the raising of umbrella handles, canes, and riding whips. The artful handle grower cuts the trees a little above the ground level and a number of saplings sprout from the roots. Then the buds of these sprouts are nipped off. By cutting the bark and training the shoots, almost any variety of design may be produced.

After two or three years the crop of umbrella handles and walking sticks is harvested and after the necessary treatment, the product is ready for the market.

If you feel that the raising of beans and potatoes is too prosaic, try the artistic cultivation of original designs in umbrellas and canes.

A New Vest Attachment to Hold the Trousers in Place

A NEW attachment for the vest holds the trousers in the proper position and prevents the vest from "riding up." Four strong loops are sewed to the vest on the inside so as to be invisible; these then pass around the belt of the trousers and fasten with a clasp. When the vest is buttoned the trousers and vest are held in position so as to look neat; if desired the belt may be worn loose so as to allow ease of movement and prevent binding. The attachment is also useful to those whose work requires considerable bending and stooping and causes the shirt gradually to work up. The principal argument against this attachment is that the vest would have to be worn summer and winter.

This belt holds the vest down and the trousers up and keeps the shirt where it belongs

A Tire Pressure-Gage No Bigger Than a Pencil

OF the same size as a pencil, this tire gage fits in the automobilist's pocket. It measures the tire pressures in five-pound increments and works on the plunger pump principle with a small piston forced out by the air pressure against a coil spring. The piston rod is graduated in pounds and has notches on one edge which keep the rod extended to the highest pressure until it is snapped back by a push of the finger.

The pencil-like gage works on the plunger pump principle

Three Roadmaking Machines in One

A NEW grader that does the work of several machines heretofore required for finishing up a road has been invented by Charles M. Anderson, of Denver, Colorado.

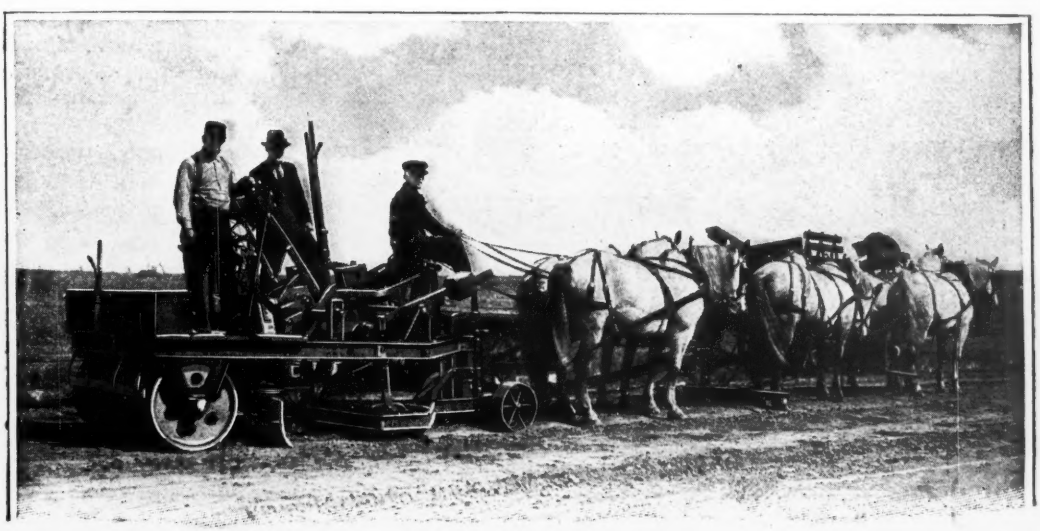
The principal element of the invention is a vertical, adjustable frame having coulters which loosen and distribute the earth. Following the coulters comes an adjustable scraper, which levels the earth pulverized by the coulters. Following the scraper is a roller which packs the ground down, forming a level road surface of any desired slope or arch, according to the adjustment of the coulters and scraper.

The frame of the machine is provided with a universally movable wheeled axle at its forward end, to which the front wheels are mounted.

This construction of the frame makes it possible to operate the machine in any desired direction and over rough and broken surfaces without danger of breaking or unduly straining the working parts of the machine. Either tractor or horse power may be used to run the machine.

Increasing England's Crops by Electricity

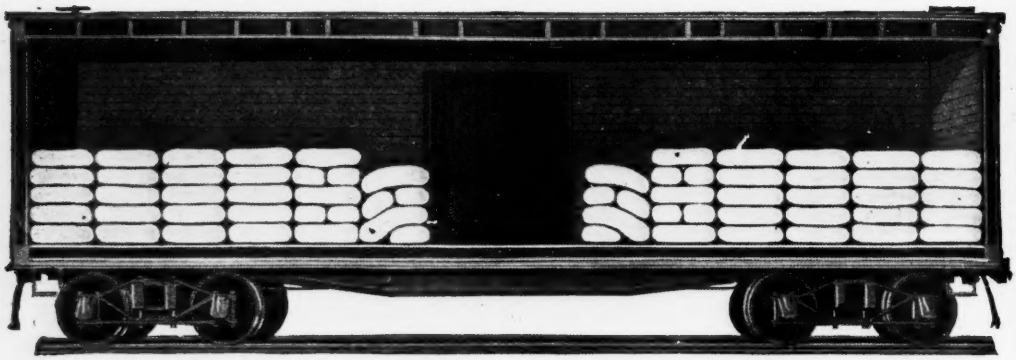
ONE way England will help to prevent German submarines from starving her out is by increasing her home crop by electricity. Experiments have been under way for determining how high frequency electric currents will best stimulate crop growth. Prof. V. H. K. Blackman, of South Kensington, the eminent agriculturist who is in charge of the work, has already shown on a small scale how oat crops can be increased from fifty to eighty-five per cent. This work is to be extended upon cereals and other field crops which will be planted over no less than fifty acres.



A road-grader which does the work of several machines. It loosens the earth, distributes it, pulverizes it, and packs it, forming a level road surface of any desired slope or arch

Solving the Car Shortage Problem

We have enough cars, if we use them properly



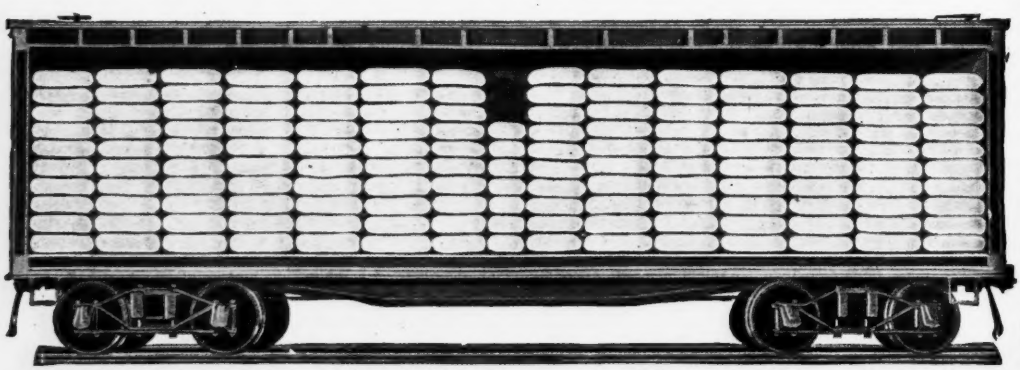
The regular trading unit of the sugar industry is four hundred bags, weighing 40,800 lbs. Notice the waste of car space. Such wastage is largely responsible for the recent car shortage

THE lack of sufficient cars is as detrimental to a railroad as a shortage of guns is to an army. The scarcity of cars which confronts America is thus one of those present-day problems which we must set ourselves to solve immediately. For upon an efficient transportation or service at home depend favorable conditions abroad.

Our shortage of cars reached its climax in May, when so much material was tied up that it would have taken an extra six per cent of the country's total equipment to move it. To add this amount of cars when Russia and the rest of Europe will tax our builders to the limit, would be as difficult as it would be unnecessary. There is a better way.

Only about one-half or less of the car capacity of the country is utilized. A buyer used to order half a carload of goods at a time. The shipper would order a car, and after perhaps several days', or even a week's delay, he would load the car and send it on its way. But the efficiency of that car hovered dangerously near to twenty-five per cent with such tactics. And all industries were much alike. Oil dealers, for instance, would buy the regular sixty-five-barrel trading unit, when nearly two and a half times sixty-five barrels could have been packed in the same freight car.

The employment of such wasted space in the trains of one railroad alone would release one hundred and twenty thousand cars for transporting the materials for building ships, for instance. The prompt loading and unloading of assignments would add a great deal more. This more efficient use of the railroad facilities in America has already resulted from the patriotic spirit. Figures show that the United States has enough cars to meet all needs properly.



A thousand bags of sugar weighing 102,000 lbs. can be loaded in the same car. The haulage expenses are but slightly increased while the efficiency of the car is raised seventy-five per cent

A Motion-Picture Projector Which Can Be Carried in a Suitcase

TO meet the present growing demand for educational and industrial motion pictures, a Chicago manufacturer is marketing a portable motion-picture projector weighing about twenty-one pounds and no larger than a small suitcase.

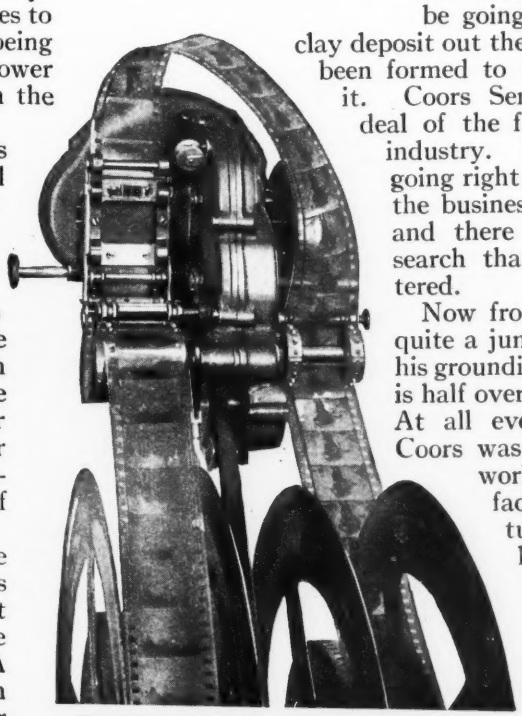
The new projector has been developed to meet all the requirements for the projection of motion pictures on short notice and under conditions which are very often unfavorable for projection.

A brilliant light for the projector is produced by a triple set of condensers and a nitrogen-filled bulb. Hence, although the regulation celluloid film is employed, there is no fire danger. The picture may be stopped and held stationary at any point without the slightest injury to the film. With this new condenser arrangement, electric current supplied from any convenient socket will throw an excellently illuminated picture anywhere from eight inches to eight feet wide, it being necessary only to lower the window shades in the classroom or office.

The twenty-one-pound portable projector is no larger than a small suitcase

The mechanism is driven by hand and may be reversed at any time during the display without adjustment, since the feed and take-up reels are arranged side by side and are both revolved by a single sliding belt. Their operation in either direction merely reverses their order of winding.

In threading the projector, the film is led under a sprocket on the right of the machine head. A semi-twist of the film brings it into proper position.



The film enters the exposure gate at the left and is led to the take-up reel at right

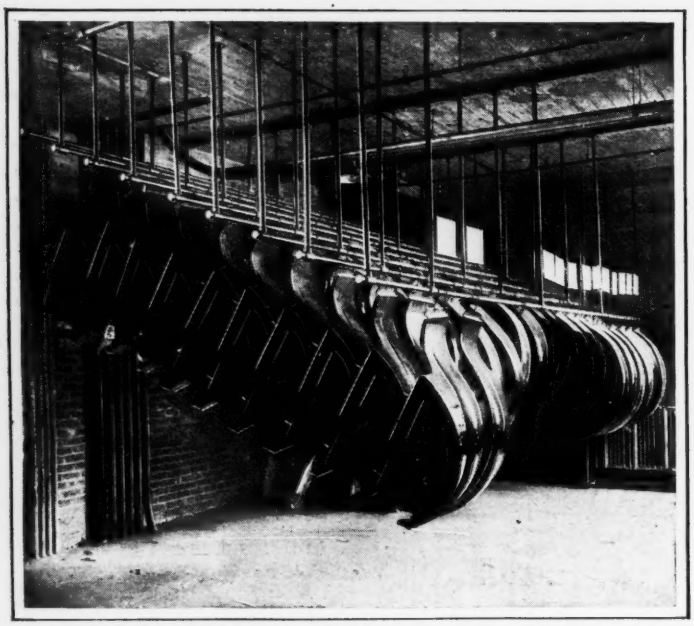
From Beer to Clay! What's Become of the Breweries?

MR. F. J. HASKIN told in the Chicago Daily News recently what has become of some of the breweries in states that have gone dry. They are used for cold storage warehouses, canning clams, making vinegar, handling dairy products, making artificial ice, packing meat, making yeast, dry cells, soap, chemicals, moving picture films, paints, varnish and "everything from ice to loganberry juice." One has become a hospital and another a church.

The Coors brewery at Golden, Col., was famous for its size and its beer, but nothing could save it against the dry wave. So one of the Coors brothers took over the plant and is now doing a thriving business in malted milk.

Another brother had prepared himself as a chemist to follow the brewing industry, and when that became impossible he undertook to help out in an investment that seemed to be going wrong. There was a clay deposit out there and a company had been formed to make tableware from it. Coors Senior had put a great deal of the family money into the industry. But things were not going right; the man who started the business had wandered away and there were problems in research that had not been mastered.

Now from ferments to clay is quite a jump for a chemist, but if his grounding is good the difficulty is half overcome before he begins. At all events, after the junior Coors was fairly started in the work the trouble began to fade away. They are now turning out a grade of laboratory porcelain that finds a ready market and will make the German ware hard to introduce again in this country after the war is over.



Automobile fenders are hung like hams in a smoke house. Floor space is saved and the polished surfaces protected

Storing Automobile Fenders Without Scratching Them

HANGING automobile fenders from step-like pipe-racks suspended from the ceiling in much the same way as hams are hung from the old smoke house for curing, is the very latest idea carried out by one of the largest automobile service stations in the country. Each fender is swung from one of the racks by means of two small wire hooks; it also hangs free by gravity. The pipe racks supporting each row are so arranged that the fenders in that row swing clear of those in the next row above or below, as shown in the accompanying illustration.

By such a method a great number of fenders can be stored in a small floor area—and space is at a premium in even the largest and the most up-to-date service stations in the country. At the same time the fenders are held in such a way that they can be taken off the racks without much difficulty and without danger of scratching them.

It Costs a Million Dollars a Year to Paint Our Navy

OUR battleships literally eat paint. The initial color requirements for a new battleship cost about twenty-five thousand dollars, which is the price of about one hundred tons of the kind of paint the navy uses. In addition to this, it is customary to repaint the different parts of a ship two or three times a year, so the annual upkeep probably exceeds this sum. This brings the annual outlay in paint for the entire fleet to a million dollars. The most important coating a vessel receives is the paint applied to the submerged parts of the hull to protect it from corrosion or barnacles.

A Clothes Closet Which You Can Take Along on Your Vacation

WHAT to do with that trunk full of summer finery when you arrive in your three-by-six room at the summer resort boarding house has been solved in a simple, practicable manner. Commodious clothes closets and summer boarding houses never go very well together, despite what the enticing advertisements have to say. But with the portable, collapsible closet of khaki cloth shown in the illustrations, one need not worry about closet room.

The khaki clothes closet when hung up for use and when folded

In folded form the khaki closet can be packed away in a spare corner of the trunk. When you arrive at the hotel you drive a nail in the door or wall, if one is not already there, and hang the cloth closet on it. A wire frame gives the top and bottom of the closet its box-like shape. When full the closet can be closed by buttoning it.

A Time-Saver for the Repairman

It locates the trouble for him and tells him how to make repairs

THE ingenious device shown in the accompanying illustration was developed to enable the automobile repair or garage man to locate the trouble on any kind of a starting, lighting or ignition system on any American-made car. It is a time saver for both repair man and owner. It enables the former to correct the trouble with the least possible delay and permits the latter to get his car back into service without long periods of idleness.

Above: Testing the electrical system of the car. At right: The box containing the complete equipment

It is humanly impossible for the average repairman to know the electrical systems of all cars. Many an owner has found this out to his sorrow by having to wait a day or two for his car because his repairman did not happen to know the particular electrical system of his car. And it must be remembered that the electrical equipment of the modern motor car is the most complex of any part of the automobile.

The device consists of a special ammeter and voltmeter, a switch and wires, a dozen small books called master charts and several hundred wiring diagrams which come in a small box, as shown. The main fact involved in the operation of the instrument is that every make of car has a definite lamp current and charging rate when it is operating properly.

After setting the instrument according to a certain one of eleven key numbers which show through small openings at the top of the dial face, according to the make of the car, it is wired up to the battery. Two handles are moved to give the proper key adjustment according to whether the engine is running with the lights off or idle with the lights on, and the center handle is moved to bring the current needle to the zero mark on the dial. If all is well, the letter "N" appears through a hole in the dial at the bottom; if not some other letter appears, according to what the trouble is. The mechanic then looks in the chart book for that letter and learns exactly what to test for next and how to do it. In this way he continues to test each unit of the system until he finally locates the trouble and finds out exactly how to remedy it.

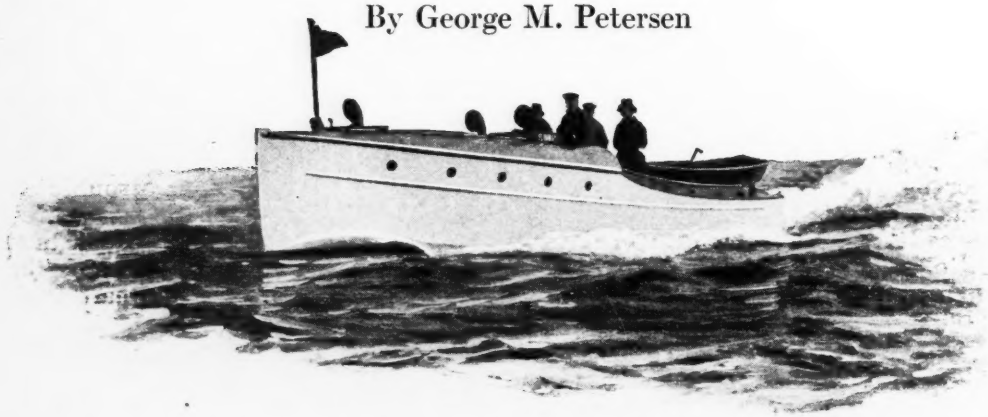
Will the Dinners of the First Trans-Oceanic Flight Be Hot?

WITH the trans-oceanic airplane flight waiting only for the termination of the war to prove its certainty, it is interesting to consider some of the unusual problems that it will bring up. How, for instance, will meals be made hot? So far as an airplane is concerned, there can be no ordinary kitchen. No stove makers or coal dealers need apply. One way in which the passengers of a small airplane could get a hot "bite" is to carry their food in a vacuum or thermos bottle. The food could be made piping hot before the flight and it would keep hot for days if necessary. It would not be a bad idea if large pockets were built in the side of the airplanes. These could be made on the vacuum bottle principle. Into these, vessels containing large quantities of already prepared and piping hot food could be stored.

Practical Motor-Boating

III.—The proper housing, rigging and the care of a motor boat when it is not in use

By George M. Petersen



PROBABLY the greatest obstacle which confronts the motor-boat owner is that of taking proper care of his boat when not in use. Of course, in a river, harbor, or in any protected water it is a simple thing to arrange to moor the boat out in the open and provide some sort of a canvas or rubber cover for it.

To cover a boat in this manner it is necessary to erect a piece of ¾-in. galvanized pipe on both the forward and after deck and stretch a piece of galvanized chain between them, using a shackle at one end so that the chain can be readily removed when the boat is to be used. These are shown in Fig. 17. The slack in the chain may be taken up by a turnbuckle at the after stanchion. The chain forms a ridge about 6 in. higher than the cockpit amidships, so that any water striking the canvas cover will immediately run overboard. The cover itself may be made of 12-ounce duck and provided with grommets which engage turn buttons on the outside of the weatherboard when the cover is pulled into place. This rigging will protect a boat not only in very rough weather, but also from the spray which splashes from the boat during a heavy blow. Of course, if one has the money, time, and inclination, he may build a boat-house, as shown in Fig. 18 and 19, or he may build a combination house-boat and boat-house as shown in Fig. 20. When building the boat-house, it is advisable to paint the inside of the pontoons with heavy asphalting paint before decking them over. Oil barrels may also be used in place of the pontoons, but as they are rather expensive and sometimes difficult to keep in position, the pontoons are generally considered to be more satisfactory. Of course, where logs are readily obtained, they are the most desirable, but even the logs should be stripped of their bark and given a coat of hot linseed oil and two or three coats of good lead and oil paint to keep them from becoming water soaked and to prevent them from sinking.

A duplex block may be suspended from an overhead beam and attached to a sling passed around the hull and the boat lifted up as in Fig. 20 *A*. Where a boat-house is not used, however, the boat must be removed from the water by means of a car, skids or rollers, as in Fig. 21, 22 and 23. If any one of these three methods is employed the boat may be secured either by blocking, as in Fig. 24 *A*, by scissor arms, *B*, board shoring, *C*, tackles, *D*, or hinged shores, *E*. Care should be taken to see that the shoring does not rest on any one plank in the hull but on several planks immediately over a rib, so that in case the hull should receive a sudden jar no serious damage will result.

When putting a boat into commission the first thing to do is to remove all loose paint and go over her planking in search of dry rot, substituting new material wherever necessary. It is sometimes necessary to remove the old paint entirely before giving the usual one or two coats of fresh paint. If the boat has blistered, if the color is to be changed from dark to light, or if there is so much paint on the hull that another coat will not look good, the old paint should be

burned off, but care must be taken not to scorch the planking.

To do this job properly, get a good gasoline blow torch and hold the flame on the paint to be removed until it blisters. It can then be readily removed with a wide putty knife. Take care to extinguish any shavings that might take fire and always bear in mind that the torch will burn the woodwork if held too long in one spot. Start at the deck of the boat and work toward the keel. After the paint has been removed, the woodwork should be well sandpapered and a thin coat of white shellac applied to hold it until the job is finished. This shellac should then be rubbed down with No. OO sandpaper before the paint is applied. If the burning is not necessary, the woodwork may be scraped with a regular cabinet scraper, care being taken not to gouge into the wood. Before commencing to paint the hull be sure that all planks are smooth; that the joints are all flush, smooth and fair and that all the holes are puttied up. Then apply one coat of good lead color and two coats of white. Zinc is not recommended for this use as it makes too hard a finish. White lead is of softer body and can be scraped down and renewed without producing ridges. The copper bottom paint is the last put on and is generally left until the boat is ready to be launched, as this paint hardens better in the water than in sun and air. Scrape, varnish, and paint the interior of the boat before she goes over. Do all the work before the boat is put in the water; for the chances are it will never be done if left until after the boat is launched. See that no paint gets on the screens covering the intake to water cooling-pipes, or closets, to clog them. Do a good job and paint every fraction of an inch of the woodwork so that your boat will be a pleasure and credit to you all season.

Scraping decks is hard work at best, but if a varnish remover is used to soften up the old varnish, it may be readily accomplished with a cabinet scraper or putty knife. The decks should then be gone over with sandpaper and well dusted before the varnish is applied. Three coats of varnish make a very satisfactory job if the woodwork is dry and warm and the varnish is applied with a soft, wide, flat brush.

The operator should become accustomed to the different kinds of buoys which will be met with on his trip. The Government has seen fit to chart the buoys for different bodies of water. The most common types are known as the spar buoy, Fig. 25, can buoy, Fig. 26, bell buoy, Fig. 27, whistling buoy, Fig. 30, nun buoy, Fig. 28, and gas buoy, Fig. 29. All of these are what is nautically known as floating buoys. There are also various kinds of spindles and beacons which are usually of a stationary nature, being built on some wreck or reef.

Buoys have been called "the sign posts of the waterways" and there is probably no definition which could define them more clearly. Red buoys should always be passed on the operator's starboard or right hand side when entering the harbor; black buoys should be passed on the operator's port or left hand side, while buoys marked with red and black horizontal bands should be given a wide berth under all conditions as they are generally used to locate a wreck or some other submerged obstruction. Buoys marked with black and white perpendicular mark

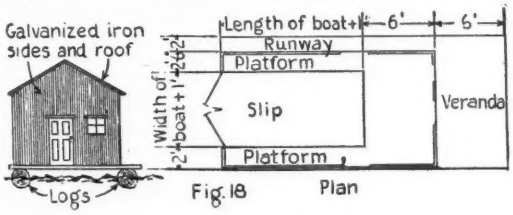


Fig. 18

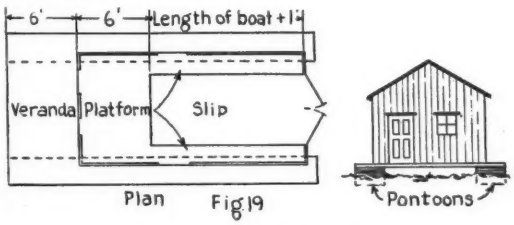


Fig. 19

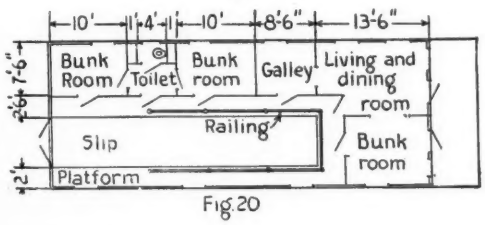
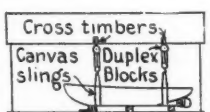


Fig. 20



Timbers laid between platforms to carry boat during the winter

Fig. 20-A

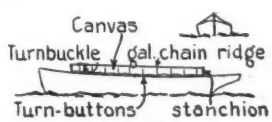
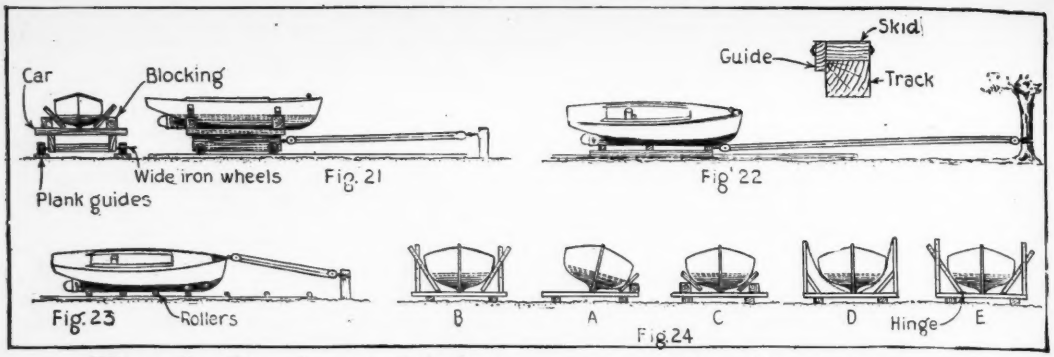


Fig. 17

Three ways to protect the motorboat from the weather when it is not in service



Where a boat-house is not used the boat must be removed from the water by means of a car, skids or rollers and the boat secured in its stationary out-of-season position by blocking

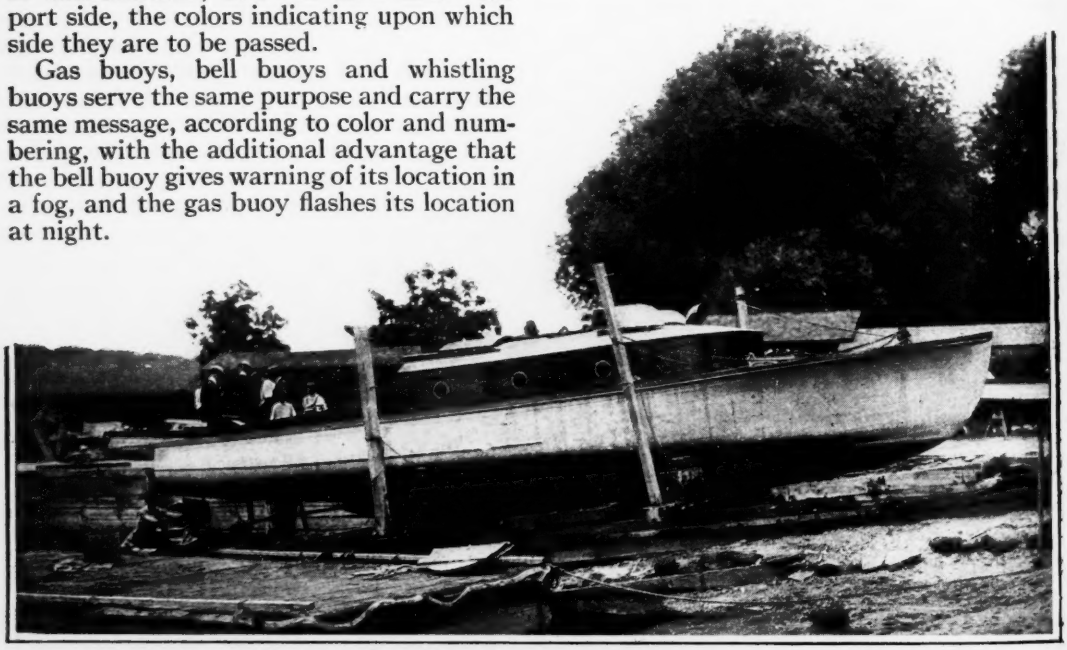
ings are known as channel buoys and are situated in mid-channel. Steer close to these on either side. These markings mean the same on any style of buoy.

The harbor or channel buoys are numbered from seaward, each harbor or channel having its own system of numbering, although the black or port buoys carry the odd numbers, as 1, 3, 5, and 7, while the red or starboard buoys carry the even numbers as 2, 4, 6, and 8. Spar buoys are placed where the water is not greatly disturbed. They are the most frequently used as they are visible at long distances. Nun and can buoys are built of steel and are used in the more disturbed waters; the nuns mark the starboard side of the channel, obstruction, or mid-channels, and the cans mark the port side, the colors indicating upon which side they are to be passed.

Gas buoys, bell buoys and whistling buoys serve the same purpose and carry the same message, according to color and numbering, with the additional advantage that the bell buoy gives warning of its location in a fog, and the gas buoy flashes its location at night.

On the chart, red buoys will be colored red, with the number alongside, and black buoys will be shown in black and numbered. Danger buoys are colored with black and red horizontal stripes, while mid-channel buoys will be marked black and white with perpendicular stripes. The operator will occasionally find buoys carrying a half number such as 4½, 5½, etc., which merely shows that a new buoy was placed after the main string had been set.

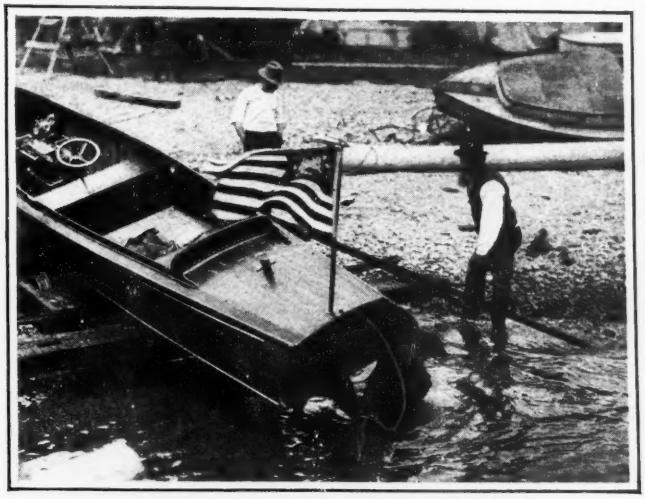
When running into shoal water the operator will usually notice a heavy ground swell; the water will take on a light green color. Rocky bottoms with little patches of sand between the boulders take on a reddish color from the weeds or a deep



Care should be taken to see that the shoring does not rest on any one plank in the hull, but on several planks immediately over a rib to prevent damage to the support from sudden jars

green from the rocks although the small white blotches of sand are usually the first to attract the attention. Of course, the preceding remarks apply to clear water and will not hold good where the water is continually agitated and clouded by mud or refuse. Swirling water usually indicates a shoal or some submerged obstruction or may be the result of a divergence of current.

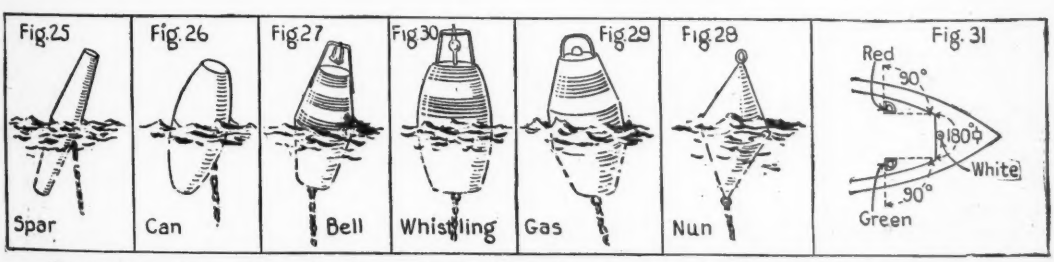
When ready to cast off from the mooring, haul in the slack on the dinghy's painter to prevent the bight from dropping into the water and fouling the propeller. Test the engine to make sure that it is running and that the clutch is working properly, and let go. Allow the boat to drop back from the mooring enough to allow you to clear it and then start ahead, taking care that you do not veer off so sharply that the stern of the boat will foul in passing the buoy or dock.



Removing a motor-boat from the water preparatory to beaching it so that it may be housed for the winter

"The Rules of the Road" are published in booklet form by the Steam Boat Inspection Service and give complete instructions as to the proper equipment for motor-boats of various sizes. Four units, however, should be included on every craft whether large or small; they are, a good heavy anchor and at least 150 feet of good heavy line to use with it; plenty of life preservers; a good substantial whistle or fog horn and the necessary lights to be used at night. These lights are rigged as shown in Fig. 31. The white light shows over an arc of 180 degrees while the starboard and port lights, called side lights, show over an arc of 90 degrees. As will be noted from the drawing, the starboard or right-hand light when facing forward is green, while the port or left-hand light is red.

Before completing this series of articles the writer wishes to call the attention of every motor-boat operator to the necessity of being courteous on the water as well as on the land. When passing a boat load of timid women and children slow your boat down rather than cause the wave from your wake to frighten them or maybe capsize them. When you see another boat in trouble run over to them and offer a tow, or at any rate ascertain whether they would like to have you send help out to them. Remember that it does not cost a cent to be kindly and you can never tell when you may be glad to have the compliment returned. Take good care of your engine. A little extra care and attention when laying it up for the winter or even when it is to be out of commission only a few weeks or days will prevent a variety of troubles later on. Investigate pecular noises. They invariably mean that something is out of gear. Ascertain the cause and remove the trouble before the engine is laid away.

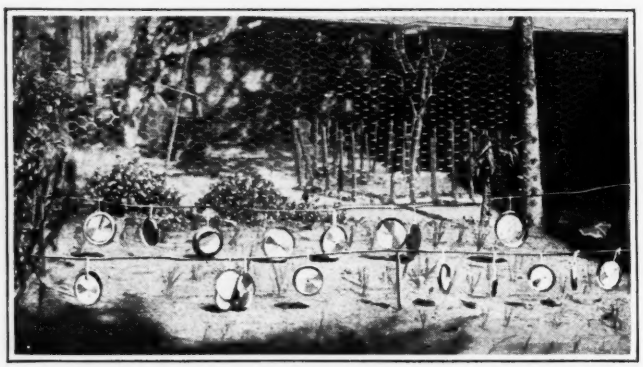


Buoys have been called the sign posts of the waterways and there is probably no definition which could state their purpose more clearly. The color designates the course of travel

A Tin-Pan Orchestra to Scare the Birds Away from the Garden

A SCARECROW is often nothing more than a place where the birds may rest after enjoying a feast of delectable sprouts.

Therefore, the farmers of Imperial Valley, California, have discarded it as a means of keeping pests out of sprouting vegetable gardens. They have found an effective substitute which keeps not only birds, but dogs and cats away. The substitution is an improvised orchestra composed of tin pans strung on wires, shown in the accompanying photograph. When the wind blows, the pans clatter together and the music set up causes the birds to move on to more harmonious quarters. Threads are attached from the wires to the branches of nearby trees, so that when there is no wind, the pans are rattled if the birds alight on the limbs. Dr. J. B. Keller, of Banning, California, is the originator of the garden orchestra.



Tin pans strung on wires make a clatter in the wind and scare the birds away from the garden or orchard

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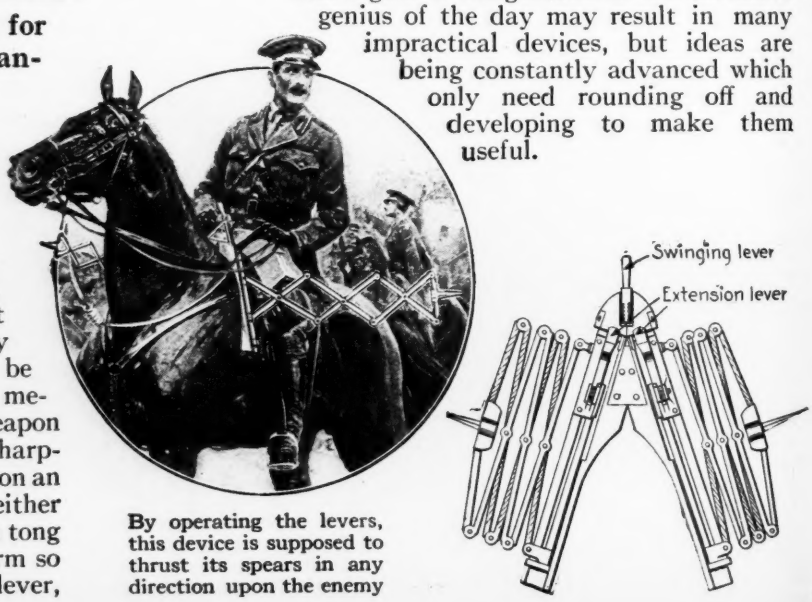
Thrusting Spears for Cavalry—Which Cannot Thrust

INSPIRED, perhaps, by the gallant use of spears by the knights of the Middle Ages, an inventor in Rock Island, Illinois, has taken out patents on cavalry spears which are to be thrust into an enemy mechanically. His weapon consists of a short, sharp-pointed spear carried on an extension tong on either side of a horse. Each tong hinges on a saddle arm so that by moving a lever, the spears can be swung in any direction. A troop of horses dashing onward with the spears facing front would have a telling effect on the enemy—in theory.

For, you see, to thrust these spears forward in the faces of the enemy would take the strength of a giant. By pulling down on the extension levers, the motion imparted to the operating racks are supposed to rotate the pinioned arms, and thus open the tongs. But unfortunately, the pinioned arm construction has been made just the *inverse* of the lever! This, together with the enormous friction which would develop by the members guiding the arms connected with the pinioned ones, would make it necessary for a *half ton* pull to thrust out the spears! Even if it were possible to thrust them, this weapon affords no protection from the opponents' cold steel! The device could hardly be expected to get further than the patent specification drawings. However, it is a patriotic effort on the part of the inventor and as such is deserving of consideration. The flights of imagination of the inventive genius of the day may result in many impractical devices, but ideas are being constantly advanced which only need rounding off and developing to make them useful.



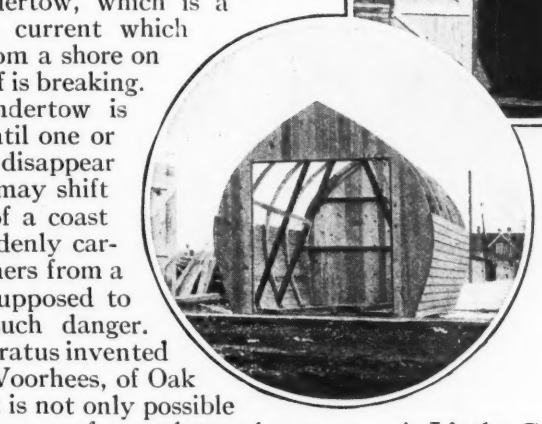
By operating the levers, this device is supposed to thrust its spears in any direction upon the enemy

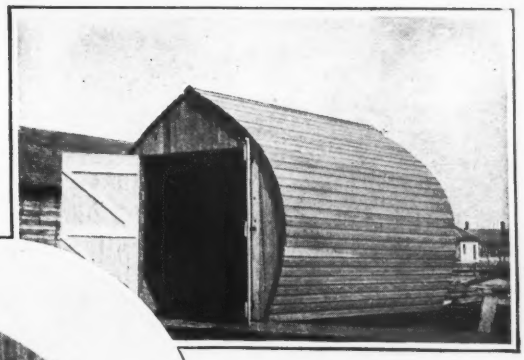
Detecting the Undertow Before It Catches the Swimmer

DESPITE the precautions taken by bathers and by beach resorts in providing safety lines, life guards, rafts and boats, each summer season a number of swimmers are swept to their death by the treacherous undertow, which is a powerful ocean current which goes seaward from a shore on which heavy surf is breaking. Ofttimes an undertow is not detected until one or more swimmers disappear from view. It may shift from one part of a coast to another, suddenly carrying away bathers from a resort that is supposed to be free from such danger.

With an apparatus invented by Martin M. Voorhees, of Oak Park, Illinois, it is not only possible to detect the presence of an undertow but to send out a signal to the bathers so that they may be warned in time to return to shore. As the accompanying illustration shows, the inventor has designed a disk with a ball lever which indicates the strength of the undertow at all times. It is set in the water, preferably at a point where the water is dangerous for unskilled swimmers to venture into. With a strong undertow running, the disk, mounted on hinges, swings outward, pulling a cable which is attached to a signal post situated on the beach.

A pull on the cable accomplishes three things: It causes the dial on the post to register the force of the undertow; it rings an electric gong, and it causes the incandescent bulbs to light. Persons hearing the gong ring or seeing the warning sign illuminated are thereby warned against remaining longer in the water in that locality.





The garage as it looks when completed. Double swing doors admit the automobile

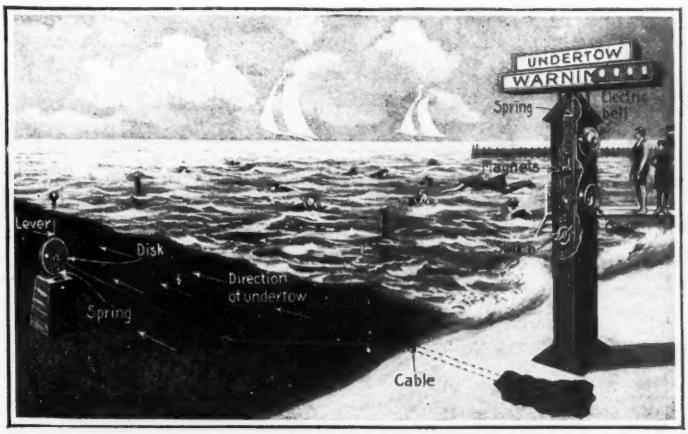
At left: The framework of the cathedral-like garage. Sharp angles are eliminated

A Little Garage Built with the Contour of a Cathedral

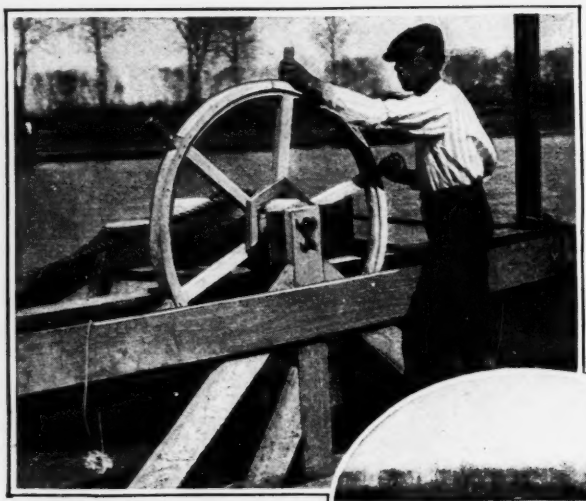
THE Gothic lines which characterize the garage here shown were not the result of any religious fervor on the part of the builder. They simply conform to a popular style of architecture now utilized in barn construction in southern Canada.

The absence of sharp angles and ugly cornices forms a pleasing contrast to the familiar style of garage which resembles nothing so much as a huge packing-box deposited in the rear of the house.

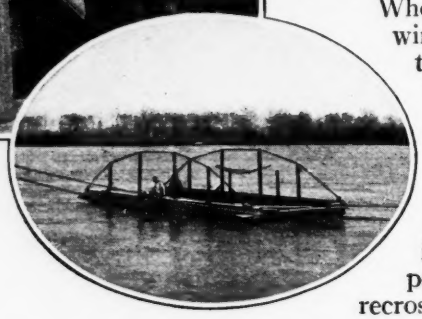
Double swing doors are used, admitting any automobile with the top up. With the possible exception of the curved side pieces this style of garage is easier to build than the usual type. Because of its sloping sides it does not offer as much resistance to high winds as the ordinary garage, and for this reason is considered safer. It has no windows.



When an undertow is running the device rings a bell and lights a warning sign telling swimmers of the danger



The pilot's wheel which controls the direction of the primitive ferry boat



The force of the current against the side of the boat carries it across stream

it is propelled by the current of the river at no expense. Two poles, eighty feet high, made of iron pipe, were erected, one on each side of the river. Between them is stretched a steel cable to receive a pulley. Ends of a rope are attached to the bottom of the pulley. The rope is fastened to each end of the ferry boat, then brought along the side of the boat and passed around the hub of a wheel, resembling the steering wheel of a steamboat.

When the wheel is turned it winds up the rope, so that the length from one end of the boat to the pulley is shorter than the length from the other end. This naturally turns one end of the boat upstream. The force of the current, acting against the boat, propels it across the river. To recross, the rope is shortened.

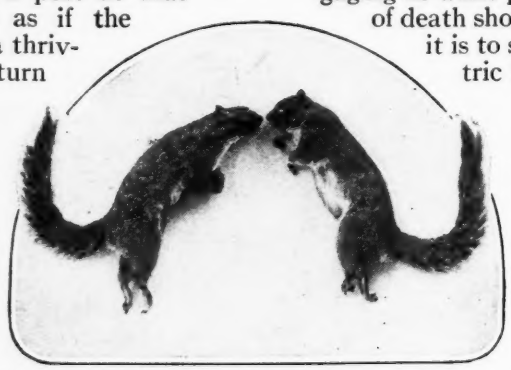
Making the Missouri River Drive a Ferry Boat

ALTHOUGH Bellevue was the first settlement in Nebraska, it never constructed a bridge across the Missouri River. In 1810, the American Fur Company had established a post at that place and it seemed as if the village would become a thriving city. But, by a turn of fate, the place remained a small town, and no bridge was ever built between Omaha and Plattsmouth, a distance of about twenty-five miles. For some time a gasoline ferry boat was maintained at Bellevue, but it was not dependable and was abandoned years ago, leaving farmers with no means of crossing with their wagons and live stock. An old-fashioned mode of crossing the Missouri river by ferry was then revived.

The old-new ferry is interesting because

Alas! The Price of This Kiss Was Instant Death

THE top of a pole carrying nearly fourteen thousand volts of electric current is a precarious trysting place. The accompanying photograph of two squirrels engaging in what proved to be their kiss of death shows just how dangerous it is to spoon adjacent to electric light feed wires. The two squirrels had evidently made an engagement to meet at the top of the pole and look for the lady in the moon.



One squirrel was on the line and the other on the grounded brace when their noses touched

Arrived there, as the latest fictionists say, they were in the act of giving the customary lover's greeting, when the touching of their noses caused a short circuit and the souls of both animals were wafted heavenward. It was indeed a kiss of death. From the nature of the burns it was established that one squirrel was on the line, and the other was on the brace which is grounded.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

An Improvement in the Clock Scheme of the Daylight Saving Plan

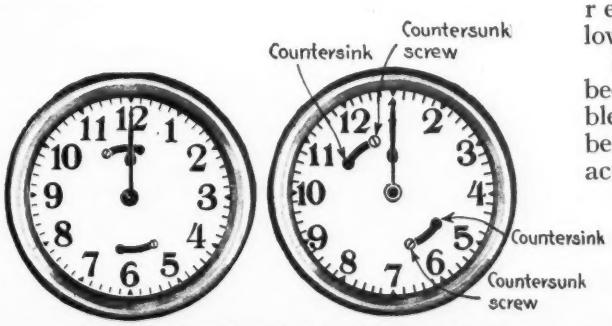
THE plan to gain thirty hours of play in the sunshine each summer month by daylight saving, ought to appeal to every pleasure and health-seeking American. It is almost equivalent to getting more pleasure for nothing. And then think of the cartload of money that will be saved in this country by a hundred and ten million of inhabitants heating and lighting their homes for one hour less each evening.

It is contemplated moving the hands of the clock one hour ahead in the spring, and turning the hands back again in the autumn. This would entail a minimum amount of confusion. People would start to work, eat their meals, and keep their engagements when the clock hands point to the customary hours.

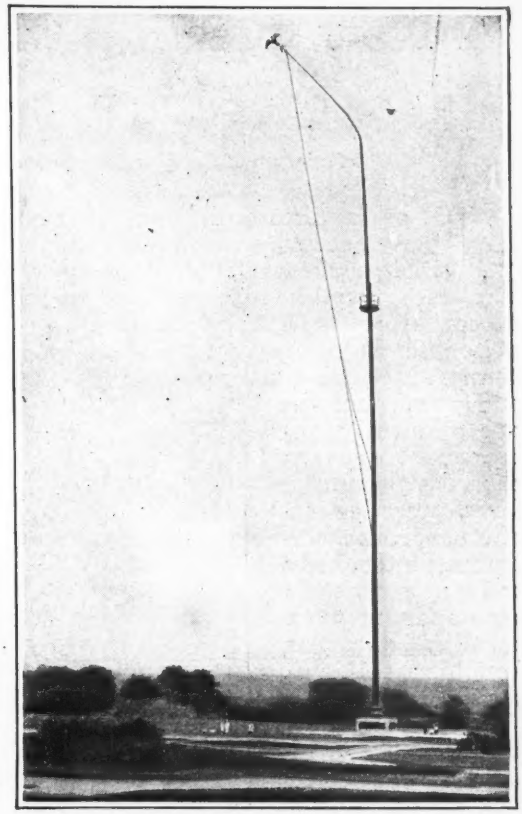
This scheme of moving the clock hands is a good one, but there is another plan which is slightly better. Why not move the clock dial backwards? The same advantages would be obtained, and besides, at noon the hands would be at the top of the clock, at sunrise and sunset they would be at the bottom, as they always have been ever since the present style of clock has been used. This could be accomplished very simply by means of curved slots and screws, as shown in the illustrations. Another way to accomplish the same purpose would be to use two separate, suitably marked dials.

This way of working out the daylight saving scheme would be really scientific. Moreover, in the case of striking clocks, it would make unnecessary, when the hour is to be set back in the autumn, the turning of their minute hands eleven times around. For the striking mechanism of these clocks cannot be set back by simply moving the hands.

Clock makers assert that the interference with the mechanism caused by altering the position of the hands impairs the accuracy of the timepiece. The hour hand should never be tampered with and the minute hand very seldom.



Instead of moving the hands ahead, the clock dial is moved back in the manner indicated



That part of the pole above the platform will have to be removed and straightened

How a Cyclone Bent a Two-Hundred-Foot Flagpole

THE zephyr which early this Spring developed into a cyclone of the first magnitude, took a hurried trip to Kansas City, Missouri, and left its card in the form of a bent flagpole in Swope Park. The pole is composed of two main sections which are divided into a number of smaller ones. In repairing it the upper main section which is fastened at the middle of the pole will be removed and lowered.

It would have been less remarkable had the pole been blown down or actually snapped off.

The bend simply indicates the freakishness of such storms and the quickness with which they change their direction.

A New Treatment for Distemper in Dogs

By Dr. George W. Little

Chief Surgeon of the American Society for the Prevention of Cruelty to Animals

NO other disease of dogs is more prevalent and, with the exception of rabies, more fatal, than "distemper," a disease peculiar to dogs and young horses. Its cause is a specific infection or poison finding its way into the system through the lungs and air passages. Young and growing animals are generally attacked. It runs a course as a catarrhal fever, affecting all of the mucous membranes of the body and is in many cases accompanied with certain nervous symptoms and eruptions of the skin.

Distemper is highly contagious and is communicated only by infection. The Scotch term for it is "the snifters," which conveys graphically to the mind one important characteristic of the disease, namely, the snifting noise—half sneeze, half cough which demonstrates the effort on the part of the animal to rid himself of the mucus which accumulates in the air passages.

Injecting inula and echinacea to drive distemper out of the dog's system

In the treatment of dog distemper many things must be impressed upon the nurse and the owner as of the utmost importance. Strict attention should be paid to the diet. No meat whatsoever should be given. Boiled rice, the broth of meat with fat removed, dog biscuit, milk and stale bread can be given. Vegetables such as peas, beans and asparagus may be mixed with the rice or other food. Food not eaten should be taken away immediately afterward.

Regarding the medicinal treatment of distemper, more specifics have been used and recommended than in any other disease in the category of dog ills. After numerous experiments and the use of all available medicines, vaccines and antitoxins, I have found only two medicines that have proved of exceptional value. These drugs are inula and echinacea. They are non-poisonous and work together to raise the natural resisting power of the blood against invading bacteria and disease.

Administered in hypodermic injections into the muscles every twenty-four hours, inula and echinacea kill distemper, finally driving it out of the system. Five or six hypodermic injections are usually necessary, alternating first on one side and then on the other side of the body. These must be made by a veterinary who understands intramuscular injections.

The improvement in the patient after two or three injections is remarkable. The dog, seemingly in the last stages of distemper, revives and recovers his appetite and there is a corresponding decrease in the severity of all the symptoms of the disease. The recovery is so rapid that the dog does not become debilitated to any great extent.

I have treated eighty cases of distemper, using inula and echinacea. The percentage of mortality in these cases is the only tangible proof, aside from the rapid recovery of the animals, upon which the efficiency of the compound can be based. Of the eighty cases treated, sixty-eight have recovered. The mortality, therefore, is fifteen per cent of the total number. The usual death rate according to the best authorities is from sixty to seventy per cent. The dogs treated were in all stages of the disease. Some had very high temperatures with pneumonia, bronchitis, bronchial coughs and typhoid symptoms.

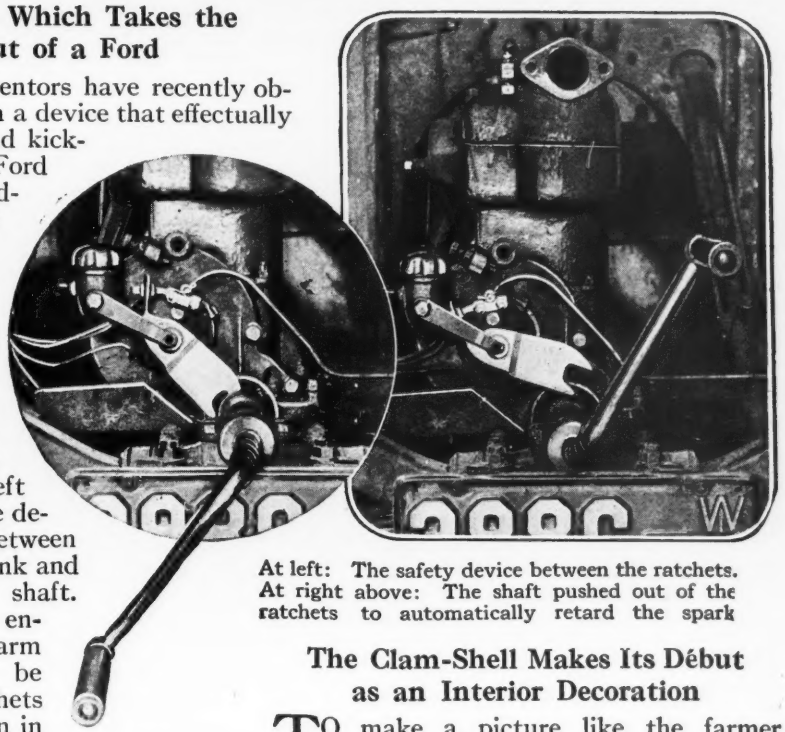
A Safety Device Which Takes the "Kick" Out of a Ford

TWO Wisconsin inventors have recently obtained a patent on a device that effectually prevents back firing and kicking when cranking a Ford with the spark left advanced. It consists of an arrangement fastened to the commutator which automatically retards the spark to the point of easiest starting when the crank is turned.

As seen in the smaller photograph at the right, the spark is left advanced, lowering the device so that it comes between the ratchets on the crank and those on the crank shaft. Before the crank can engage the shaft, the arm of the device must be pushed out of the ratchets on the crank, as shown in the large photograph. Pushing this arm out automatically retards the spark to what has been found to be the point where the motor starts easiest. After this the crank is free to start the motor.

However, it is impossible to start the motor until the device has been pushed out as far as it will go and the spark retarded. Of course this is not necessary where the spark has been retarded before cranking. But in the majority of cases where injuries have been sustained while cranking a car, the spark has been advanced a considerable distance. It is impossible to advance the spark from the seat while anyone is cranking the car. The arrangement can be put on the car without removing the timer or changing or altering any parts.

More than fifty different models were experimented with before one was found that met all requirements. With this device in operation, practically all danger is eliminated from the cranking up.



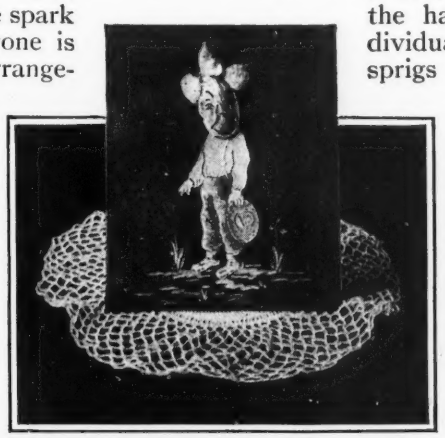
At left: The safety device between the ratchets. At right above: The shaft pushed out of the ratchets to automatically retard the spark

The Clam-Shell Makes Its Début as an Interior Decoration

TO make a picture like the farmer boy in the accompanying illustration, you need not be a gifted artist or even a good photographer. All that is needed to secure a perfectly artistic effect is a square of colored cardboard for mounting, a figure cut out of a magazine, fashion sheet or advertisement, and a bit of white cotton or black or brown wool such as is used for crocheting or knitting, and a clam shell.

The lines of the face are made with pen and ink. The cut-out figure is first pasted on the mounting board; then the clam-shell head is adjusted and stuck on with mucilage. The placing of the hair affords scope for individuality. The grass and sprigs of flowers are painted in. If you happen to be somewhat of an artist, you can paint in the whole figure, but very good effects are obtained with the paper cut-outs.

If the trousers are cut from sandpaper, they will afford a convenient place on which to scratch matches. The placard can then be hung on the wall near the matchbox.



The clam-shell farmer boy with paper cut-out body and hair of cotton

Lest the Engineer Forget

A new automatic train stop which promises to prevent disaster should signals be disregarded

© Underwood and Underwood

The engineer misunderstood or forgot the signal. This was the result

DID you ever ride in a locomotive cab, faithfully eyeing each signal as it flies past, figuring on how the next signal is likely to be, watching the gages on the locomotive, and looking after all the other contrivances? Did you ever walk along a picket fence, trying to count the separate staves as they went by? In spite of your best efforts at concentrating, didn't your mind presently wander? Didn't the whole thing finally become a big muddle? Do you wonder, then, that the engineer, working under the strain that he works under, sometimes misses his count of the signals as they go by, forgetting whether the last one read "Danger" or not?

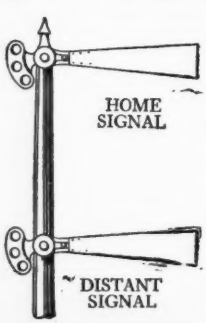
How to eliminate the human element in train operation is one of the really big propositions before the railroads today.

Some years ago the New York, New Haven and Hartford Railway offered a prize of $10,000 for an automatic stop which would meet all the rigorous conditions imposed—something which would not be affected by sleet, snow and cold, which would not require expensive changes in standard equipment, and which would not fail oftener than once in a million times, which is about the record made by the electro-pneumatic signals in the New York subway. It was also pointed out that special regard should be paid to traffic conditions on steam railways and to the fact that any automatic control system must be capable of application to high and low speed passenger trains as well as to freight trains.

A host of inventors have applied themselves to the problem. No less than fifteen hundred and seventy-four plans for automatic train stops were offered to the railway company as the result of this prize offer. The inventors all aim to establish an arrangement such that if the engineer does forget or overlook a signal, his train will be brought to a stop automatically.

The trouble occurs when an engineer runs by a home signal and into the next block in which a train may already be standing, or a bridge washed out, or other trouble manifesting itself. He runs into the train, or off the embankment into the river. The whole system was designed to prevent this wreck, yet it was powerless to do so because the engineer overlooked or didn't mind the signal set at danger. If the signal's mandates could be enforced, whether the engineer paid attention to them or not, the much-to-be desired system would be attained. This brings us to the reason why inventors are endeavoring to produce automatic train stops. Present-day railroading is like the country would be were there plenty of laws but no police and courts to enforce them. There are many rules and regulations in train operation, and signals to point the way, but there is no means of enforcing them. Nor will there be, unless the new train stops prove to be all that present-day inventors hope for them.

All train stops operate on much the same principle. They all seek to set the brakes of an advancing train, should the signal read "Danger." To set the brakes on any train it is only necessary to open a certain valve connected with the air system on the engine or underneath a car. The automatic stops, as a rule, all aim to get at this valve when the train is in danger and open it. The practical method of doing this is hard to work out, and constitutes the barrier which has prevented practical train stops from being invented and put into operation long ago. To stimulate inventors to devise



The general design of block signals

Showing a train seeking to enter the block beyond the "home" signal. Engineer knows by the fact that "distant" signal is up that the home signal is also up, even though he may not be able to see the latter, due to smoke, fog, or an obstruction

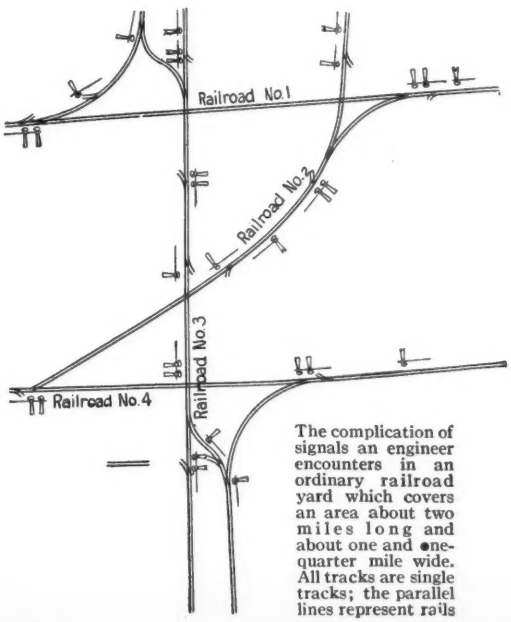
Engineer sees that the distant signal is down and knows that the home signal is also clear. He therefore goes ahead at the regular or full speed. A "home" signal is so called because it is nearest "home"; or in the block the train seeks to enter

Something is wrong. The distant signal is down without the home signal being correspondingly clear. This shows how a block system sometimes fails. Automatic train control is designed to stop the engineer safely at home signal in such a case

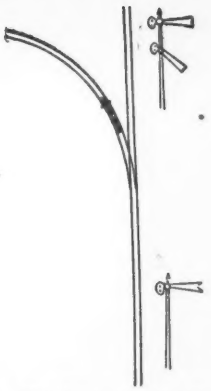
these much-needed contrivances, the Government has for several years maintained a corps of trained investigators who will go to almost any part of the country and test out free of charge any invention of the kind that gives promise of being worth while. Moreover they will make an authoritative report on its merits, if it proves worthy of attention. This corps has given much practical aid to inventors, and done much through suggestions to standardize and improve the inventions being put out. At present we are on the road to a practical train-stop.

To illustrate the general train-stop situation specifically, we will show how one of the best train-stops operates. Let us take the type recently perfected by Jean F. Webb, Jr., of New York city. As the pictures on page 438 show, the apparatus is affixed to the buffer-beam at the front of the engine. Other inventors attach their stop to the tender, or even beneath the cab. Some have attempted to locate most of the apparatus along the roadway and have it struck by a projection on the engine as the latter goes by. This, however, seems to be a wrong plan in most cases, since the great force of such a broadside impact may result in breaking the apparatus to pieces.

The ramp principle Mr. Webb uses is beginning to be recognized as the most satisfactory out of the number of alternatives. As the engine and train approach a block signal, the shoe part of the apparatus runs up a short piece of inclined rail, or T-iron, say thirty feet long. This piece of inclined rail is called a "ramp." As the shoe rides up over the ramp it opens the air valve on



The complication of signals an engineer encounters in an ordinary railroad yard which covers an area about two miles long and about one and one-quarter mile wide. All tracks are single tracks; the parallel lines represent rails

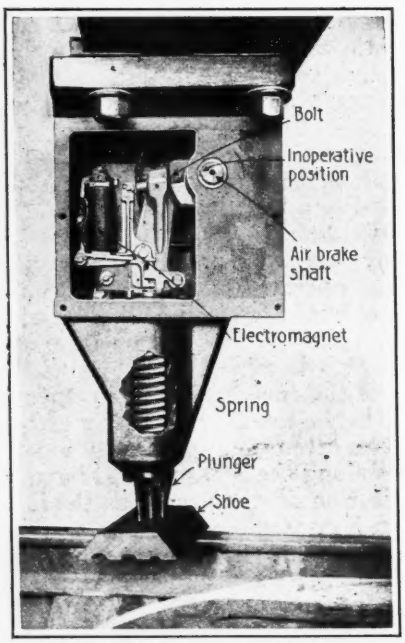


Showing more complicated signals than the preceding. Engineer has whistled for sidetrack. Towerman accordingly gave it to him, at the same time lowering the lower of the two arms at the home signal—which indicates that everything is ready for the train to proceed to side track

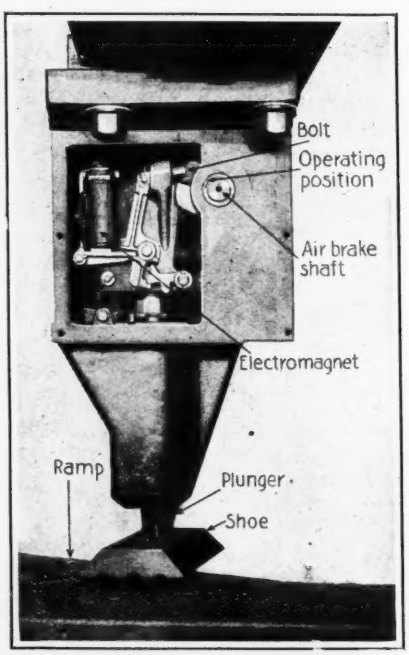
Still more complicated signals, showing what mixed up propositions an engineer encounters. He must read the signals almost instantly and correctly or cause trouble for himself and train. Here signals mean main line is closed but sidetrack is open

the train in the manner explained in the illustration. Should the block ahead be clear, electric current comes off of the ramp at the same time that the latter is causing the air valve to open. This current works the electromagnet shown, and sets a catch or bolt so that the shoe in descending automatically closes the valve again, thus letting the train proceed unhindered. If the block ahead is not clear, there is no electric current at the ramp, the electromagnet therefore can not set the bolt, and the result is that the shoe and its plunger descend off the ramp without closing the valve in the process. The latter therefore remains open where it has been pushed, the brakes become set, and the train comes to a halt.

How the electric current gets into the ramp to perform this setting of the bolt feat is too long a story to tell here. The current comes from a roadside battery which is a part of, or at least under the control of, the regular block-signaling system and its signal arms. This establishes the needed cooperation between the signals and the automatic stop, and causes the stop to enforce the signal's mandates, which is the end desired. Besides opening the air valve at least momentarily at every ramp, whether it is needed or not, Mr. Webb's apparatus sounds a whistle in the cab at the same time, confirming the other indications. A governor also comes into action, preventing the engineer from going beyond a certain speed in a danger zone.



The Webb device. When the engine should stop, the shoe rides up an inclined rail and actuates the brake mechanism



The shoe is here shown sliding downward and off the ramp, closing the air valve so the train can proceed in safety

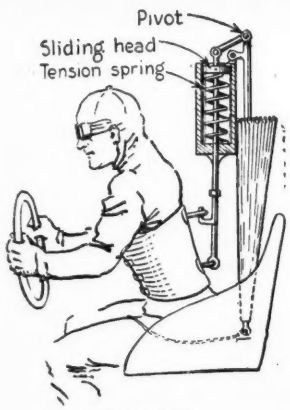
New Answers to the Query, "Why Does a Cat Have a Tail?"

THE question having arisen, "Why does the cat have a tail?" the scientists seem willing to answer it with another question, "How would the cat look without a tail?" No one can gainsay the fact that the tail is a valuable ornament. The cat without one is a sorry sight. But there are those who maintain that the tail serves the cat as a sort of gyroscope, balancing the body in leaping. This cannot be wholly true, for Manx cats get along very well without tails, and rabbits have no use for them at all. Yet both the Manx cats and rabbits do a lot of leaping. After all it looks as if the tail is only an ornament, unless it is a kind of safety valve for expression in exciting times.

Of course there are instances where the tail serves some purpose other than that of art. The monkey finds his useful as a sort of fifth leg; the horse uses his as a fly-swatter, as does the lion; the crocodile uses his for swimming, as do the seal and the turtle and other aquatic creatures; and the rattlesnake uses his for warning enemies. According to W. D. Matthews, of the American Museum of Natural History, the tail was a necessary organ for the aquatic and amphibious ancestors from which the higher animals are descended. When they took to terrestrial life and to walking on all fours, the tail became more or less superfluous.

A Parachute Life-Preserver for Aeronauts

It is ready for any emergency and acts automatically—says the inventor



The instant the aviator is thrown out of his normal position, the spring is released and the parachute stick is straightened out automatically

In most accidents, the aviator has little time to act. Just here lies the value of this device, when coupled with an efficient parachute

EVERY ship carries its cork-jackets for passengers. Is there no life-preserver which the crew of an aircraft can don in an emergency? The parachute at once suggests itself. Prearranged parachute leaps have often been made from airplanes. Conditions are different if the airplane is beyond control, owing to the quickness with which disaster overtakes one in the air. There is no time to think. Then there is the difficulty of getting clear of an overturned machine which itself drops like a stone. The critical point is the automatic unfolding of the parachute in the air through the initial drop itself, which demands that it must be just slightly unfolded below so as to be ready to catch the air.

Kaja P. Togstad, in inventing a parachute that would remain efficient in an accident, has evidently realized these difficulties and taken a step in the right direction. He would throw a parachute automatically into the correct opening position by mechanical means. As the picture shows, he supplies his parachute with a central stick like an umbrella's. The stick doubles on itself in the middle, so that the whole contrivance can be carried on the aviator's back. A coiled spring automatically unfolds and straightens the stick the moment the aviator leaves his normal position in the machine. The device would, however, seem feasible only if the parachute was no larger than an umbrella. Although so small a parachute would somewhat retard the fall, there would be scant comfort for the bereaved family in knowing that the aviator was picked up after a fall of nine thousand feet with only a broken neck and not with every bone shattered as usual.

The place of this umbrella-like contrivance might conceivably be taken by a really efficient parachute (of twenty-two feet minimum diameter) made of cloth and ropes so thin, yet strong, that it might be folded into a small enough bundle at the end of the stick which by the same mechanism, might be thrown instantly and automatically into the proper position to catch the air and open promptly.

In use, the parachute device is fastened to a corset-like belt which the aviator dons when preparing to make his ascent. The swinging staff section is held down by means of lashings, which allow the wearer to walk about in the machine so long as the parachute is collapsed. After the aviator takes his place in the seat of the airplane he releases the lashings so that the staff will be free to operate but will be held back against the seat and prevented from action unless the aviator is thrown out or moves suddenly from his seat.

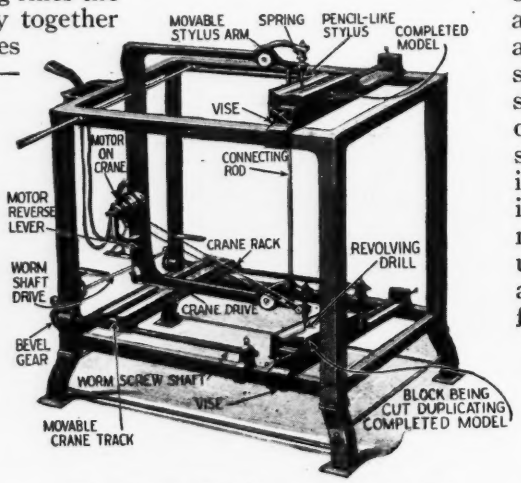
Standardizing the Die-Sinker

An automatic machine which can produce fifteen dies in the time formerly required to make one

By Herbert F. Sherwood

WHEN you have four hundred drop forgers to keep busy and wish to turn out from 200,000 to 250,000 forgings in the course of every twenty-four hours, you begin to take thought as to how you can save in the necessary operations. Do any pieces require three different manipulations when two will answer? Are there any machines, or can any be invented to reduce hand work?

One of the necessary details of making drop forgings, of course, is that of producing the dies. The pattern's the thing. It must be exactly right, cut to the one-thousandth part of an inch of the desired dimensions. In making rifles the dies must fit so closely together when the hammer comes down that the "flash"—in other words, the excess metal which spreads out around the forging between the two dies, will be like paper for thinness. The thinner the flash, within reason, the greater the production from the trimming presses which later cut off the halo of metal.



By means of this machine one die can be made in eight hours. One man can supervise three machines

In a Bridgeport, Conn., plant a way has been worked out not only of standardizing the process of making dies to serve as models, but of adapting the principle used in copying statues and making jewelers' dies by machinery, to the sinking of larger dies. In the making of a standardized article, such as a bayonet, however, and where considerable numbers of large dies are required, it has been demonstrated that it is practicable and economical to plan out in advance the different operations required in the making of a given die and specify them on a card of directions accompanying the block of metal from which the die is to be made. The outline of the desired die is drawn upon the coppered surface of the block and the directions specify what cuts shall be made, and the exact depths which shall be given to them. The cutting tools that shall be used are also named. One workman may not necessarily perform all of the work. Some of it may not require an expert's attention.

The model completed, it is put into a machine which carries also an uncut block. This machine is equipped with two arms connected so that they will work like a pantograph. At the end of one of these arms is a pencil-like stylus of metal whose point, pressed against the model, follows every indentation in and out. To the other arm is attached another stylus, also about the diameter and shape of a carefully sharpened pencil. This one, made of very hard steel, revolves so rapidly and smoothly that its cutting edges cannot be seen. As the upper stylus moves up and down across the face of the model in parallel vertical lines five one-thousandths of an inch apart, the fast flying pencil-like stylus below follows suit across the uncut surface of the lower block. With the same undeviating evenness of speed that characterizes the movement of the earth around the sun, it engraves a reproduction of the model.

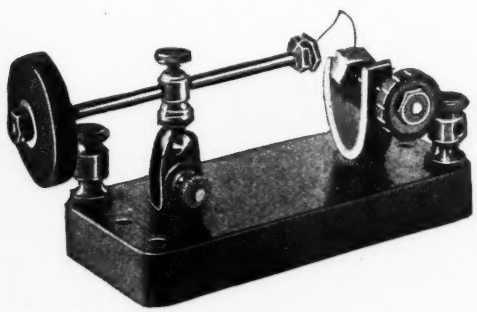
Ordinarily, by the old methods it would require one man's time for from thirty-six to forty hours to produce the die. By means of this machine, the same work can be done in eight hours, and one man can supervise three machines. In this way fifteen dies can be produced by him in the same length of time which was formerly required for one. Owing to the more automatic character of the work, a less experienced man can be employed for this part of the operation at less cost.

The Amateur Electrician

And Wireless Operator

An Easily Adjusted Ball-and-Socket Detector-Stand

A DETECTOR-STAND capable of especially easy adjustment, on account of the ball-and-socket arrangement of the movable arm, is illustrated herewith. The ball was taken from a butt-hinge; a binding-post was re-threaded to fit the stud attached to the ball, as shown. The socket is made from spring brass, and holes slightly smaller than the ball are drilled very near the ends. A tension-screw is fitted to the socket, which is three-quarters of an inch long with a knurled nut for easy turning.



The ball-and-socket joint makes an easily adjusted detector for wireless apparatus

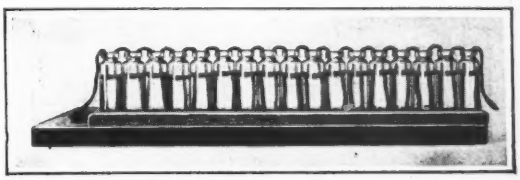
The mineral holder is a U-shaped piece of quarter-inch brass rod flattened at the bottom. Near the end of one leg a hole is tapped with an 8/32 tap and an 8/32 thread is also tapped in the bottom of the clamp so that it may be fastened to the base.

The base may be taken from an old spark-gap or cut out of fiber or hard rubber and drilled to suit. It should be about 2 in. by 4 in. The arm is made of ⅛-in. brass rod 3 in. long; threaded 8/32 at each end. A binding-post may be mounted on it to carry the "cat-whisker" wire or mandolin-string, or nuts may be used on the arm end for clamping the same as a binding post.—FRANCIS W. NUNENMACHER.

A High Tension Audion Battery Made of Medicine Vials

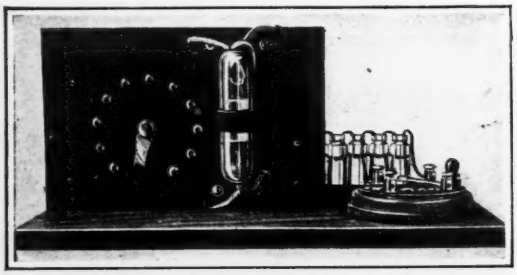
WHEN using audion or similar tubes, a battery giving from 30 to 40 volts is necessary. Such a battery made up of small flashlight dry-cells is most convenient but costs as much or more than the tube itself. Dry-cells also have what is known as "shelf life." This means that they deteriorate even when standing idle (on the shelf evidently). In a year's time, more or less, they will have lost their strength and their voltage and current will be near zero.

As the high tension current consumed by the audion tube is extremely small, a battery may be made up of very small storage cells, when a direct or alternating lighting current is available for charging them. With alternating current, however, a suitable rectifier must be used. The battery cells may consist of small medicine vials with strips of roughened lead for plates. Such a battery is shown in the illustration, mounted directly back of the panel holding the tube and voltage-regulating switch. The vials are conveniently mounted in a row between two wooden cleats so that they will not topple over. Small wires are led from the switchpoints and soldered to the tops of the lead strips. The lead strips should not reach to the bottom of the vials. A drop or two of light oil on top of the electrolyte will tend to prevent acid fumes from arising and tarnishing parts of the apparatus. When charging with 110-volt



Cells of battery made up of small medicine bottles with strips of lead for the plates

alternating current, an aluminum plate rectifier must be used in series with the battery, together with a small lamp or other suitable resistance. The aluminum plate of the rectifier may consist of a small alumi-

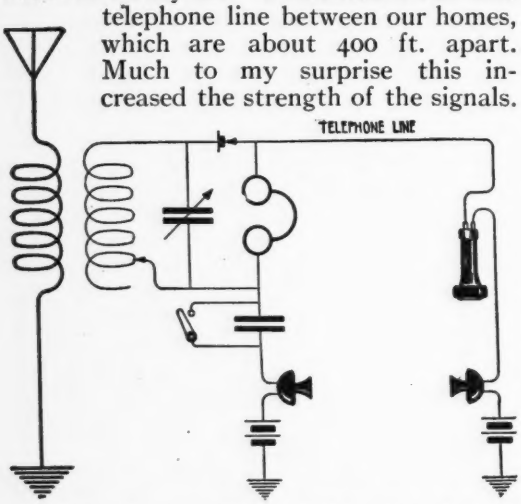


A type of rectifier used with the battery for charging it from an alternating current

num wire with its point just dipping into the rectifier electrolyte. As the battery is small, the charging current must also be small. A gentle bubbling at the plates is sufficient. This battery does not hold its charge very long but it is a simple matter to charge it each time before use, as a double throw switch will change the current to the charging circuit or to the apparatus quickly.—R. V. WILSON.

Wireless Signals Transmitted by Telephone

THE diagram shows how I enabled my friend who had no wireless outfit to listen in on my set. I installed a one-wire telephone line between our homes, which are about 400 ft. apart. Much to my surprise this increased the strength of the signals.

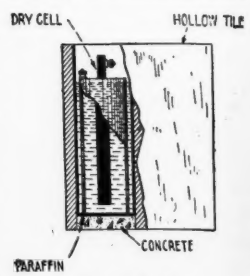


Wiring diagram of the telephone line showing its connection with the wireless set

As an additional pleasure we were able to talk over the telephone while wireless messages were coming in.—C. WILTSEE TUFTS.

An Effective Method for Recharging Dry Cells

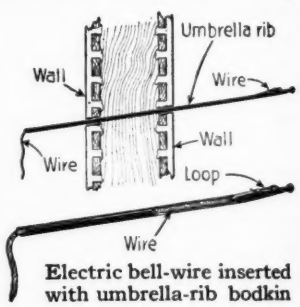
WHAT I have found to be the most effective method for recharging dry cells consists in making over the construction of the cell and placing it into some container. Such a container may easily be made from a hollow tile such as is used in building construction. These tiles are cut to the height of a dry cell by a hammer and chisel. The tile is then stood upright on a flat board and enough concrete is poured in to fill the bottom of the tile an inch deep. After the concrete has set, it is coated with a thin layer of melted paraffin which is then allowed to cool. The bottom of the dry cell is then knocked off and the inside compounds, with the exception of the sealing compound, are then taken out. A number of holes are then punched in the cell, and it with its carbon is then immersed in an "active" solution poured into the tile. This solution is made of sal ammoniac and soft or rain water in the proportion of 4 oz. of sal ammoniac to 1 qt. of water. —THOMAS W. BENSON.



Dry cells in a container

Running Bell-Wires Through Walls with an Umbrella-Rib Bodkin

AN umbrella rib may be made to do excellent service in running electric bell-wires. Such a rib is not a great deal larger than the diameter of the bell-wire, consequently it can be run through a small hole. The wire is stripped of its covering for a short distance and threaded through the little loop near the end of the rib. The wire is then pressed snugly into the trough of the rib, which can be moved around while searching for the opening without disturbing the wire. The ball on the end of the rib facilitates its easy passage through the opening.—JAMES M. KANE.

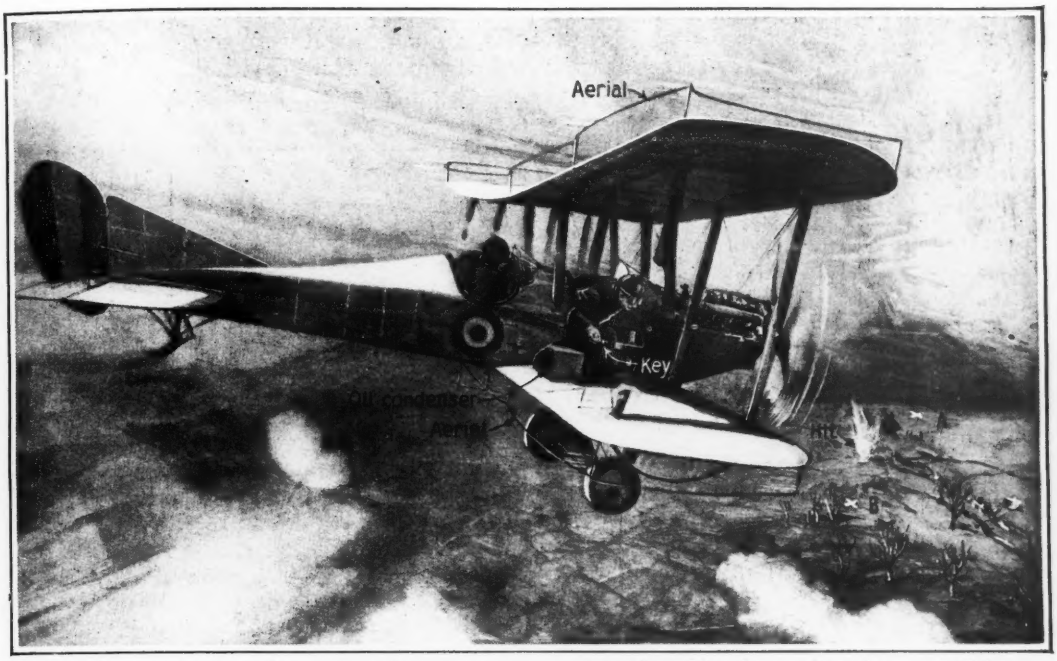


Electric bell-wire inserted with umbrella-rib bodkin

Fighting the Big Guns with Wireless

Thrilling adventures of the airmen while signaling the range to the artillery gunners

By Captain A. P. Corcoran, Late of the British Army



The airman signals to the gunners the range necessary to make a hit, after seeing where a shell has dropped and exploded at or near the enemy's lines. When a hit has been made he glides away

IF you are interested in wireless, you have probably at one time or another tried to operate an instrument of your own. And to do so, you have probably repaired to the seclusion of your own room, well removed from outer disturbances. Even then you have probably found difficulty in getting signals. Perhaps a cat howled, or your sister put her inconsiderate head in at the door, and diverted your attention for a moment. You know how little it takes to upset the accuracy of an operator.

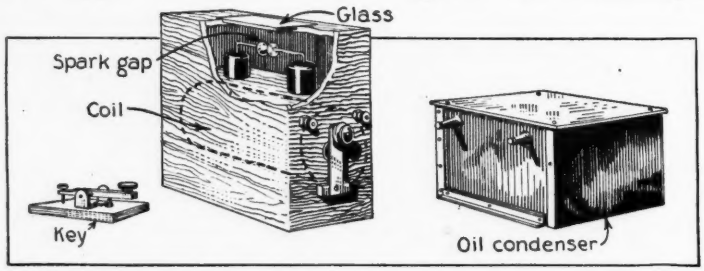
And now, if you are to get an adequate idea of the task of the wireless man in this war you will have to try to put yourself for the moment in his place. You will have to imagine yourself not safely housed, but up six thousand feet in the air, with only a few pounds of wood and a few yards of canvas between you and a very certain death. You will have to imagine that all round you dozens of shrapnel shells are bursting, and that to right and left of you are enemy airplanes, hot on the trail of your car. Through the midst of this sea of peril you are piloting your ship, with one eye on the dangers immediately threatening you; another on the ground for the information you are seeking; and still a little attention centered on the tiny wireless set, without which all your work would be in vain.

You have heard the airplane picturesquely described as the "eyes of the army." That is a very accurate description of the part it plays. It is through the airplane that the artillery gets an effective range on the enemy batteries, or locates the enemy ammunition dumps, or a light field battery, or convoys, etc. It is through the wireless set attached to the airplane that the firing is directed. Without the wireless, the airplane would be of little use.

There are various types of machines used in the war, but the two principal ones are the Hugh battleplane and the small Bristol biplane, the latter being used for scouting work alone. But no matter what the car, the wireless set is the same. It is the Wilson set.

As you might imagine, the set is small and extremely light. It comprises just a 4-in. spark coil, a manipulating key, a small fixed oil condenser, contained in a steel box, and an aerial coil. This helix or aerial coil is not made of the usual copper tubing, bound on a wooden frame. It is made of several turns of soft flexible insulated wire wound round a piece of wood and kept securely in place by two cross-pieces of wood.

The lay-out of the apparatus is not necessarily uniform. Usually the airman shifts it to suit his own convenience, but as a rule its position is this: The condenser and coil are placed under the seat; the aerial coil is made fast to the framework near the operator. The key is on a small wooden shelf fixed to the side of the seat, and sometimes it is placed on a partition in front of it.



The operator's set comprises a four-inch spark coil, a manipulating key, and a small fixed oil condenser, all in a steel box

In the case of the small scouting machines, the aerial is fixed on the top of the wings and runs round the edge, while the lead-in wire is brought in from the center. Then the earth or ground wire hangs over the side of the plane to the same length and capacity as the aerial. In these cars, of course, the pilot and operator are identical. Only one man goes up.

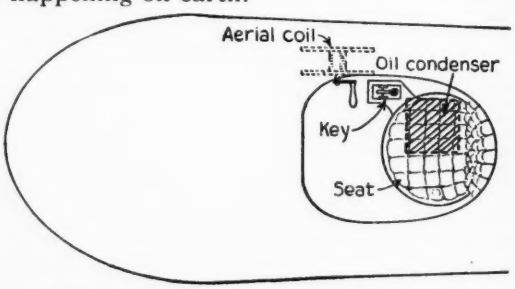
In the big battleplanes, the aerial is in much the same position. It is fixed to the top of the top plane. But the ground wire is arranged differently from that on the scout machines. Here it is attached to the bottom of the bottom plane. In other words, there is an upper and lower capacity, just as in the Lodge-Muirhead system.

Now in these planes the operator is the observer. He sits in front of the pilot. But, in case he should be shot or in any way incapacitated, there is a manipulating key in the pilot's pit joined in parallel to that in the observer's chair, so that either man is in a position to operate.

There is, of course, no receiving apparatus. So far it has not been found necessary. For if you are traveling at the rate of 120 or 130 miles an hour, which is the speed many of these planes are able to make, it is hard enough to breathe without wasting effort in trying to hear. Besides, even if the rush of air would permit you to collect your senses, there is still the propeller to be reckoned with. The noise of this close to the ear can be compared only with that of a forty-coach express train tearing at top speed through a tunnel.

But suppose it were possible to perfect an instrument that could make itself heard against these handicaps, of what use would it be, when completed? Under the circumstances in which the airman fights, instructions from the earth are of no use to him. He is the one man in the war who fights as an individual. Once he has left the earth with general orders as to the object of his flight, he takes advice and instruction from no one. The thoroughness of his work, the chances of his safety are matters left entirely to himself. They depend solely on individual initiative.

Let me take you with him on a trip, typical of one he might make any morning that is clear enough to let him see what is happening on earth.



The condenser and coil are placed under the seat and the key on a shelf near by

The artillery has got the range roughly and set their sights accordingly. The airman ascends, and is soon soaring over the enemy lines. Now he is in sight of the target.

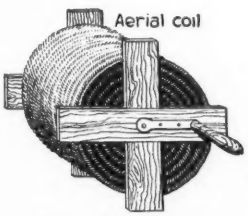
He signals "G" back to the artillery. That means "Go! Commence firing."

They fire. In a couple of seconds there ascends a streak of smoke. To his eye it is no bigger than the puff of a cigarette, but it

tells him that the shots from his artillery are not reaching the target.

"D 300, L 100," he signals. That means, "Lower the range 300 yards and come 100 yards to the left."

A few more seconds, and there is another puff of white smoke. Again it is short of the target.



The aerial is made of copper tubing

"U 100, R 50," he signals; meaning, "Raise the range a hundred yards and shift it fifty to the right."

Again he waits; and this time he has his reward. Now the puff comes from exactly the right spot.

"H," he signals back, repeating the letter several times. It means, "Hit."

The artillery have got the range.

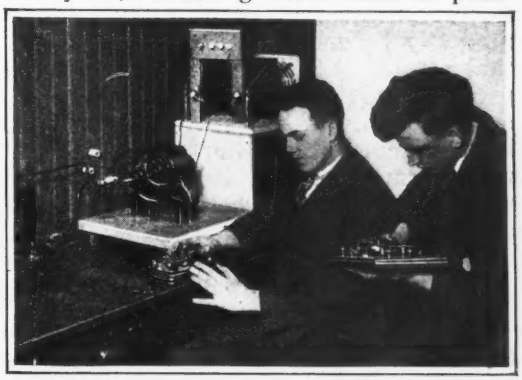
Sometimes they get it more easily than this. But often they take much longer. And the longer they take, of course, the more perilous for him. For meantime, naturally, he himself has become a target. Shells from the anti-aircraft guns have been exploding to right and left of him, but he manages to soar away from these. Then something worse looms up. The enemy airforce is preparing to meet him. They are leaving the ground. He knows they will soon be on him. Unless he hastily disappears from the scene there is soon in progress one of those great duels in the air—but that is another story.

Down with the Old-Time School Bell! Supplant It With Wireless

ONE of the technical high schools in a large city has worked a new variation on that old-time institution—the public school bell. Time was when brassy-sounding bells used to adorn every schoolhouse steeple in the land. In the larger cities these have retired in favor of a system of electric gongs, one in every room. This system is useful for calling classes during a day as well as for gathering the whole flock of pupils together at nine in the morning—this last being about the sole function the earlier steeple bells could perform. But this school in question goes a step farther than even the electric gongs, connected as the gongs are with networks of wires, annunciators, time-clocks and the like. It is done here by wireless.

The change came about through the fact that the school long ago became too big for the original building, even though it was large and well equipped. Since then surplus classes have been held in such buildings in the neighborhood as could be secured. How to call and adjourn simultaneously the successive classes throughout the day in all these buildings therefore became a problem. The principal suggested that it be done by wireless, and the school's class in radio-telegraphy completed the system, the essentials of which are shown in the diagram.

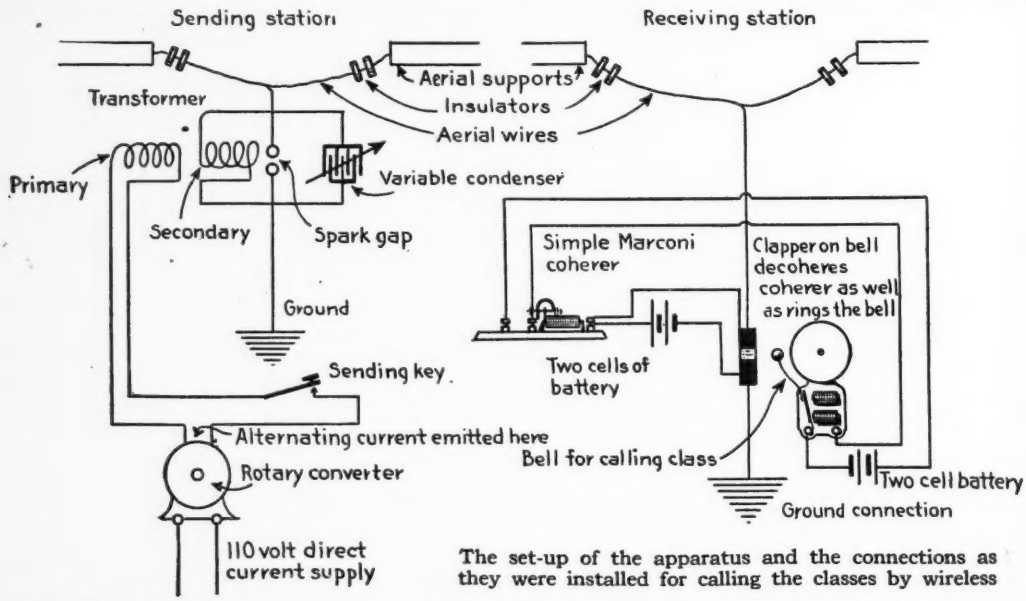
The sending end of the system is unusual only in that a small rotary converter is used to convert direct current—the only supply available—to alternating, for the transformer. Had alternating current been available this could have, of course, been hooked on at the same place as that of the converter, and the system would have worked as well. The receiving circuit uses a coherer made of metal filings in a small glass tube in the usual way. Interposed between the coherer and the bells, which do the calling of classes, is a pony relay of the kind often used on ordinary railroad telegraph circuits. The object in using a relay is that its high resistance takes less current than the bells would if connected directly to the coherer. When heavy currents go through a coherer they cause the filings to stick together permanently, or nearly so, rendering them hard or practically impossible to decohere. The coherer, as is evident from the diagram, is placed in close proximity to the clapper on one of the bells. Thus the clapper automatically decoheres the coherer, doing away with any special apparatus for that purpose.



Instruments in use by a technical high school for calling the classes by wireless

A one-kilowatt transformer sends out a wave sufficiently powerful to operate co-

herers and call bells of this type over a distance of several blocks, and of course over much longer ranges if the receiving apparatus be made carefully and adjusted with delicacy. Circuits of the simple type here used are likely to be very sensitive to static during summer months, passing thunder showers causing the bells to ring more or less continually, the frequency of the rings of course depending on the number, distance, and strength of the lightning discharges causing the static. But in such an event the system automatically becomes a storm detector, and that pleases youthful investigators all the more. Or, it affords an opportunity for experimenting with contrivances of one kind or another for doing away with the trouble caused by the static, and that in turn offers an alluring field for the exercise of ingenuity.—L. E. DARLING.



The set-up of the apparatus and the connections as they were installed for calling the classes by wireless

A Binder for Water Colors and a Wood Filler

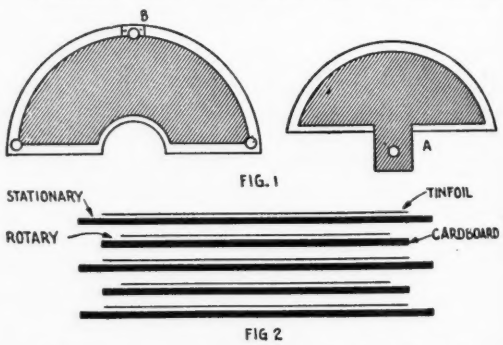
CASEIN is a good binder for water colors, but as it contains alkali it is not safe to use with certain chemical pigments. In this case glue, or any adhesive that is neutral, may be used. Casein is easily dissolved in ammonia, caustic soda, potash or carbonate of soda, but a more economical alkali is quicklime, which does very well when the material is to be used in making a wood filler. Roughly speaking, one quart of quicklime is sufficient for four parts of casein.

How to Make a Variable Condenser for Five Cents

THIS condenser can be made at a cost of about five cents. First cut the plates out of cardboard, the thinner the better. Then paste onto each sheet of cardboard a piece of tinfoil about 1/16 in. smaller all the way round, except at *A* on the rotary and *B* on the stationary plates, where the tinfoil should be continued out to the edge for a connection with lines.

The tinfoil should be put on one side of the cardboard only, as the cardboard acts as the dielectric, as in Fig. 2.

Washers can be used as separators.



The condenser plates are made of cardboard and tinfoil stuck together with shellac

Five stationary and four rotary plates, six inches in diameter, using the so-called "shirt cardboard" as the dielectric, will have a capacity of approximately .0005 microfarads.—RAYMOND ROOF.

Wireless Work in Wartime.—II.

Learning the operating thoroughly and setting up a buzzer telegraph line

By John L. Hogan, Jr.

IN the increased demand for wireless operators which has been created by the conditions arising from the declaration of war, the idea seems to prevail that a competent and useful telegrapher can be trained in a course extending over a few weeks of time. Nothing can be further from the truth. The beginners, who are now taking up radio telegraphy for the first time, will have many months of study to carry through before they will be really competent. Until they have become thoroughly familiar with the code and the basic principles of radio telegraphy they will not be dependable; without dependability the radio operator is not only valueless but dangerous. It cannot be too strongly urged that the training of a radio telegraph must be complete and thorough and that it is utter folly to attempt to cover so extensive a subject so rapidly as to make its complete absorption an impossibility.

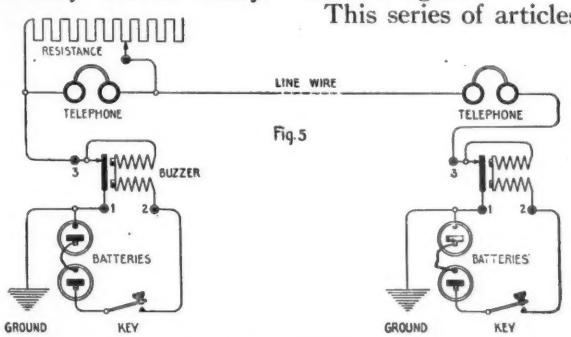


Fig. 5

A buzzer-set with its connections for sending messages from one room or place to another in learning to operate a key in wireless telegraphy

The Study of Radio Operating

Although the several branches of radio telegraphy involve a good deal of study, the work of learning it is probably one of the most interesting occupations that a person of scientific inclinations can find. There is a good future for well trained radio operators, both in wartime and in the days of peace. The number needed because of the present crisis is larger than normal, and more will be required from month to month. The trained operators who are now available will take care of the immediate needs, and those who are at present studying in the various telegraph and radio schools throughout the country will be utilized in the near future. The newest students will have their opportunities as soon as they secure their training, but until they are thoroughly prepared it is unwise to place them in responsible positions. It is also unwise for the students to attempt to speed up their courses of training by extreme abridgment, in an attempt to learn "only the fundamentals." Thoroughness should be the watchword of every beginner; a little time spent in study of the important details will be more than repaid by the greater progress which will result as soon as the practical work is begun.

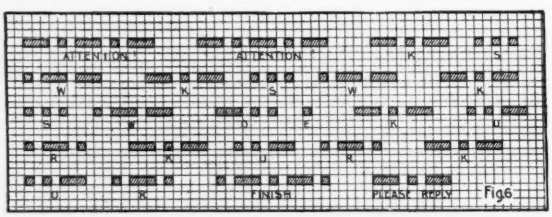
This series of articles, which was begun in the August issue of the POPULAR SCIENCE MONTHLY, is designed to point out methods of study of radio-telegraphy which will result in thorough training in the shortest desirable time. Only the most elementary knowledge of electricity has been assumed, but even the skilled radio experimenter is likely to find some points discussed which are unfamiliar to him. The first article took up the commencement of the study of the Morse code, as a preliminary to telegraphy itself. The simplest subdivisions of the Morse alphabet, for aiding in memorizing the dot-and-dash symbols, were explained, and a description of key and buzzer practice was given. As soon as the student has learned to form the first three groups of letters correctly, as set forth last month, he should commence signaling practice with a companion who has progressed to about the same point in the study of telegraphy.

Setting Up a Buzzer Telegraph Line

The first step in communication is to set up a buzzer telegraph line between two points which are so far apart that the telegraph itself is the only means of communication. If you put one end of the line in one room, and the other close by in

another part of the nouse, there will always be the temptation to call from one "station" to the other and to make corrections in that way instead of depending strictly upon the Morse signals. Only by relying upon the line and Morse signals exclusively can the best practice be had.

An excellent system of connections for a practice line is shown in Fig. 5. For each station there are needed a buzzer, dry cells, telegraph key, and telephones. Almost any sort of buzzer or telephones will do, though it is better to get a buzzer which gives a high musical tone and to use telephones of the usual wireless type. The small buzzers which can be purchased from any electrical supply store have fairly high tones and are very good. There are special "wireless" test buzzers made, which have three connection points and which are designed to give a very high and clear tone of about the same sound as that produced by a modern radio-telegraph station. This is the best type to buy. The preferred telephones are of high resistance (about 2000 ohms total) and consist of two "watch-case" earpieces mounted upon a headband which automatically holds them in place and so leaves both hands of the operator free for sending, writing out the message being received, or adjusting his apparatus. An advantage of buying both the buzzer and the telephone of the sorts used in regular wireless telegraph work is that both may be used later on when radio-telegraphy itself is taken up.



In answering a call at the other station acknowledgment of the call is sent in return

Wiring the Two Stations

The diagram, Fig. 5, shows how the two buzzer telegraph stations are to be connected. First the dry cells and the key are connected in series across the two ordinary terminals of the buzzer, marked 1 and 2 in the figure. Then the binding post 1 is connected to earth, and a wire is attached to the contact post near the buzzer armature, marked 3 in the figure. This wire is connected with one terminal of the telephones. To make sure that everything is in good shape at either station, the remaining terminal of the telephone may be connected with the ground, so placing the receivers in series between terminals 1 and 3 of the buzzer. If the adjustments and wiring are correct the buzzer will operate whenever the key is pressed, and the tone of the buzzer will be reproduced loudly in the telephone receivers. If the tone is so loud that it becomes annoying, a resistance of several hundred ohms may be connected across the telephones as shown in the left hand station of Fig. 5. If this resistance is variable, as it is in a potentiometer used with radio receivers, the loudness of the sound in the telephone may be made anything desired by adjusting the resistance so that any chosen portion of the line current will be shunted around the winding in the "by-pass" circuit.

Assuming that both stations have been set up and adjusted to operate properly, it is only necessary to connect the outer terminals of the two telephones by means of a line wire. This line wire may be of almost any kind since it carries very little current. Any copper wire may be strung from one station to the other; it need not be larger than No. 30, and does not require careful insulation unless the distance is large. When the two stations are set up completely, as in Fig. 5, pressure of either key should result in a corresponding clear signal tone in *both* telephones. If it does not work out in this way, go over the circuits in detail and be sure that they are correctly connected and sufficiently well insulated. The earth or ground connection may be made by wrapping a bare wire around a scraped water or gas pipe, or a steam radiator. For convenience the ground lines may be discarded and a second line run between posts 3 of the two buzzers.

The diagram shows the variable shunting resistance at only the left-hand station; obviously the same plan may be used at both ends if the signals are too loud. The incoming signals are likely to be somewhat weaker than those made by the buzzer at the home station when sending, but if the line wire is of sufficient size and well enough insulated this difference in intensity should cause no trouble. Under some particularly poor conditions it may be found necessary to shunt the telephones while sending and

to use them directly in the circuit (or shunted by an extremely high resistance) while receiving.

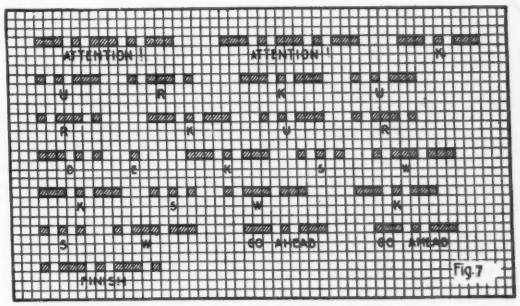
How the Call Signals Are Made

In taking up code practice over such a telegraph line, the usual wireless methods of calling and signing should be followed. Since every radio telegraph station has certain identifying call-letters assigned to it by the Government, the two practice stations should select call letters. Let us suppose that the left-hand station chooses the call signal KSW and the right-hand station KUR; these groups of letters will designate the corresponding station and that one only.

Having arranged the line and apparatus so that every pressure of the sending key at either station may be heard as a corresponding short or long buzz or tone in the telephones at the other, the sending of messages may be begun. The time for the first trial having been set, both students should be at their instruments, and listening to the telephones. Let us assume that it has been arranged that KUR, the right-hand station of Fig. 5, shall signal first. The operator there will follow the International calling method and first send the "attention" signal, dash-dot-dash-dot-dash, two or three times as shown in Fig. 6. This is a general signal which precedes transmission of radio messages, and is merely to catch the attention of the receiving operator. Having signaled *attention*, the call letters of the station desired are now formed three times in succession: KSW KSW KSW, as is also shown in Fig. 6. This part of the call serves to notify the operator at KSW that he is wanted by some other station. The next part of the call is the French word "*de*," meaning *from*, which is immediately followed by the thrice repeated call letters of the sending station: KUR KUR KUR. At the close of this signature, which indicates the name of the station from which the call is sent out, the operator makes the *finish* signal, dot-dash-dot-dash-dot and then signals the letter "K." These two characters used in this way mean: "I have finished sending and will listen immediately. Please reply."

Answering the Call Signal

The operator at the other station, upon hearing this call, realizes that KUR desires to open communication with him. Therefore he sends an acknowledgment of the call signal and an invitation to transmit, in accordance with Fig. 7. This consists of the attention signal sent twice or three times, the signal letters of the calling station (KUR) sent three times, the word "*de*" (from), his own signal letters (KSW) three times, "K" several times (meaning "go ahead"), and the finish signal. The first operator, at KUR, then knows that the second station KSW is ready to receive the messages to be sent, and proceeds to transmit them. In the course of a message the sending operator occasionally makes a mistake; noting this, he at once stops



The usual wireless method of calling and signaling should be taken up in code practice

sending and signals a question mark dot-dot-dash-dash-dot-dot, then repeats the previous word correctly and continues with his message. If a receiving operator fails to receive the entire message correctly, in his following period of sending he requests a repetition of the words missed. This is usually done by sending the last word received correctly and following it by several question marks (dot-dot-dash-dash-dot-dot) and the next word correctly received. If the receiving operator gets correctly everything sent to him, he signals "R" (meaning "Received Correctly") several times at the beginning of his next period of transmission. Thus complete conversations are carried on and acknowledged or corrected. The detailed form of sending commercial messages is somewhat more complicated, but the simpler method just outlined will prove ample for practice work.

The practice messages should at first be made up of words including only the letters of the first three groups of Fig. 2, in last month's article. As soon as all of these letters are perfectly familiar and easily recognized when their Morse sounds are heard, the remainder of the alphabet may be memorized and worked into the code

and message practice, sending the words most used in army practice first, then others later as the operator becomes more proficient.

Careful Sending Is Essential

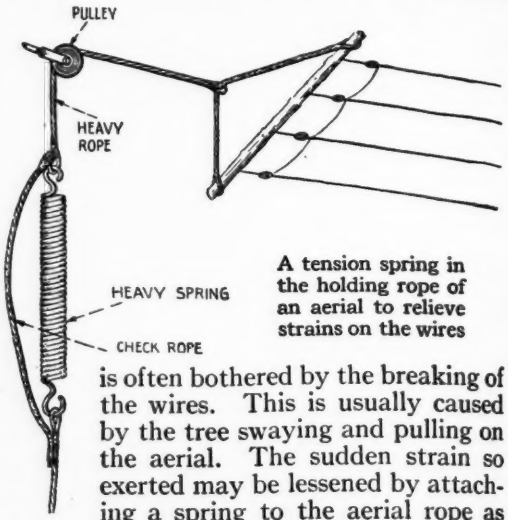
In sending, strive always to make carefully and accurately timed dots, dashes and spaces. Give particular attention to the length of spaces between letters and between words, as explained last month. The receiving operator will not be able to write down your letters correctly unless you form them correctly, and without careful sending many serious errors may result. In calling, for example, be sure not to run the call-signal letters together. Each time the call is sent, pause for a word-space before repeating it; otherwise instead of hearing three well separated groups of letters (KSW KSW KSW) the receiving operator will get a jumble of nine letters (KSW KSWKSW) and will not be able to tell whether your call is KWS, WSK or SKW. Similarly, keep the "*de*" well separated from the call letters themselves, and the "Attention" and "Finish" signals sharp and distinct. Beware especially of making the "Attention" signal sound like KA, or the "Finish" signal like AR, by introducing an extra dot space that should not be there at all.

When copying messages sent from another station, even in the very beginning of practice, wait till a single letter is completed and then write down that letter *in script*. Never write out the dots and dashes themselves; the letters should be transmitted to you sufficiently slowly, and with enough space between each pair of them, for you to write out the letters themselves. As you become more and more skilled you will find it possible to carry an entire word or several words in your mind before writing them down. To do this, however, requires much practice and an excellent familiarity with the Morse code.

The two-station practice method described in this article, according to which two students progress together, is far better than studying for Morse reading by the use of an automatic sending machine alone. The ideal method, however, combines the two. In the next article some further points to be considered in operating will be explained, together with an arrangement for combining several stations and an automatic sender on a practice buzzer telegraph line.

Relieving the Strains on an Aerial Fastened to a Tree

THE amateur who has his aerials suspended between a house and a tree

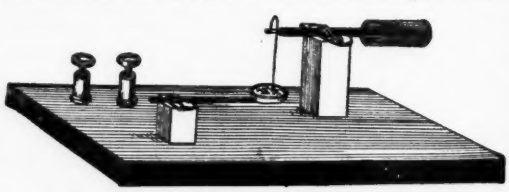


A tension spring in the holding rope of an aerial to relieve strains on the wires

is often bothered by the breaking of the wires. This is usually caused by the tree swaying and pulling on the aerial. The sudden strain so exerted may be lessened by attaching a spring to the aerial rope as shown in the sketch. The spring stretches when the strain becomes greater than the wires will stand with safety. A check rope should be attached to the spring so that if the spring should accidently break the aerial will not fall.—PAUL L. KEATING.

An Inexpensive and Quickly Made Detector

HERE is a detector that can be built in half an hour. It is simple to make and easily adjusted. Upon a base 3½ in. square, mount two spring connectors on top of small blocks at the sides of the base, as shown. The spring connectors may be taken from an old dry-cell. A piece of cat-whisker wire—mandolin E string—is soldered to a small rod which is inserted in the loop of one of the spring connectors. The end of the rod is threaded and provided



A detector made of scrap material mounted on a wood base with wire connections beneath

with a small insulating handle. The other spring connector holds a piece of No. 14 copper wire, to which is soldered the cup of an old dry-cell.—E. F. JASPERS.

Sustained Wave Telegraphy Between the United States and Germany

BEFORE 1913 there was no direct means of communication between Germany and the United States, except by submarine cables. The Allies cut these cables immediately war was declared. Between that time and our own break with Germany, communication was established by two of the most important pairs of wireless stations ever known. And now that all active amateur and

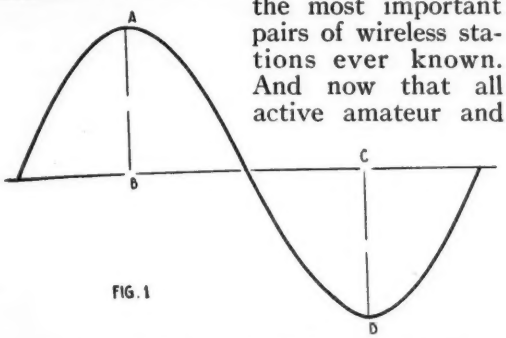


FIG. 1

Curve representing progressive values of the current generated by a radio alternator

semi-professional work has been discontinued, this ought to be just the time for our friends to *study* the "workings" of these great stations.

The quenched singing spark systems, which were used for almost all radio work at the time these stations were erected, were first tried at Sayville, but proved entirely too feeble for the distance that had now to be covered, about 4000 miles. The sustained-wave system was therefore installed at Sayville, and it was found to be reasonably successful. Exceedingly high frequency sustained alternating currents were used in all four stations. For generating these, the stations at Eilvese (Germany) and Tuckerton (New Jersey) used the Goldschmidt "reflection" system, while those at Nauen (Germany) and Sayville (Long Island) used the Arco-Joly "multiplication" system.

The secret of the success of sustained-wave telegraphy lies in the fact that high frequency alternating currents—that is, the currents which go through many changes in direction in a second—are better radiators of energy from the sending station, while they also enable the receiving instruments to respond more strongly. As an alternating current generator revolves, the strength of the electromotive force it produces varies as shown in Fig. 1. The strength of the electromotive force first increases until it reaches its maximum as shown by *AB*. It then decreases and finally becomes negative, reaching a maximum negative value *CD*. It then reduces to zero again and becomes positive in value once more. By greatly increasing the speed of the generator or by increasing its number of poles it is possible to increase greatly the number of times the electromotive changes in direction per second, and in this way, to increase greatly the radiation efficiency of a station. However, due to the fact that a machine cannot easily be made sufficiently strong in the one case and that the electrical efficiency may be too greatly reduced in the other case, this simple machine method was not used for these high power stations. The transformer methods of Goldschmidt or of Joly were therefore adopted, rather than the radio frequency dynamo of Fessenden and Alexanderson, used so extensively before the war.

The Goldschmidt system depends on the phenomenon called "reflection." That is, the currents set up in the rotating part of the alternator (the rotor) can be "reflected" back into the stationary part of an alternator (the stator) so that the frequency of the original rotor current is increased to double the original. This can be made to take place by a suitable electrical connection on the stator. Again, the induced current set up in this manner in the stator can be "reflected" back into the rotor. The frequency of this new current last set up will be increased to three times the original frequency. Finally, on reflecting

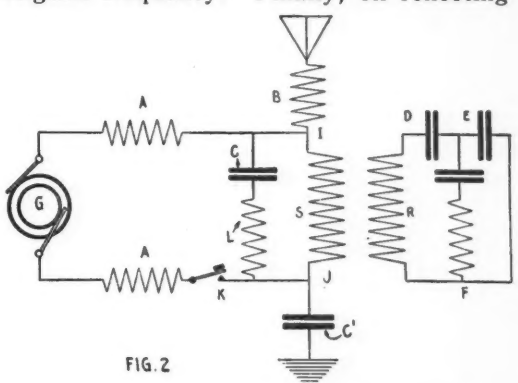


FIG. 2

Goldschmidt "reflection" alternator for quadrupling the frequency of the original current

this once more into the stator, the resulting current frequency will be once more increased, and to four times the fundamental. This is the current that was used in the antenna.

Alternating current is supplied by the generator *G* to the stator *S* of the Goldschmidt alternator through the choke-coils *A* and the interrupting key *K*, as shown in Fig. 2. As the alternator is revolved by an auxiliary motor, the current set up in the rotor *R* is made very large by connecting the circuit *DEF* to the rotor so that the impedance, that is, the apparent resistance, to the current is made very small and the current made correspondingly

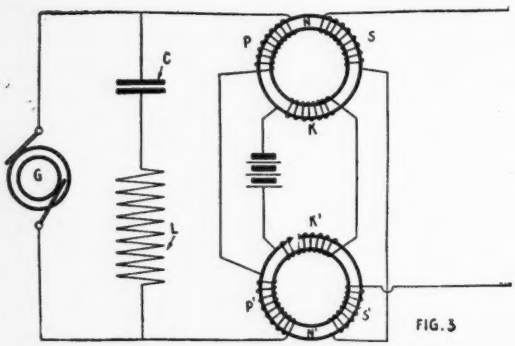


FIG. 3

One of the two frequency-doubling transformers of the Arco-Joly sending system

large. The current is then reflected back into the stator as explained before, and the new current of double the original frequency is also provided with the tuned electrical path *CL* so that the impedance for it is also very small. Reflecting the current again into the rotor gives another current of three times the original frequency. This too is provided with a circuit of very small impedance, which allows the current to become comparatively large. The last reflection takes place from the rotor to the stator and it is this current that was used in the antenna. To accomplish this, the antenna was connected to *I* and the ground was connected to *J*, as shown in the diagram; the loading coil *B* and the condenser *C* having been adjusted until the antenna was tuned to agree with the last reflected frequency.

In this manner, currents which have the high frequency of 60,000—or 60,000 cycles of changes in direction per second—were readily obtained. The alternator was driven at a speed of nearly 10,000 revolutions per minute. The best results were found to be obtained on reflecting the currents four successive times. Theoretically, there is no limit to the number of times they may be reflected, but practically on reflecting them more than four times, the electrical and magnetic losses become excessive.

The Arco-Joly system uses a number of separate transformers so constructed that the frequency of the initial current is doubled every time it goes through a transformer. The construction of the separate transformers is as shown in Fig. 3. The transformer has two independent cores and an auxiliary circuit *K*, *K'* supplying a direct current, which is sufficiently large nearly to saturate both of them magnetically. The initial current is supplied to the primaries *P* and *P'* of the transformers by the alternator *G* and the curve representing its strength is an ordinary sine curve as shown by *ABCD* in Fig. 4. The capacity *C* and the inductance *L* are made of such values that the impedance of the circuit *CLP'P* is very small. This causes the current in that circuit to become correspondingly large. On account of the manner in which the auxiliary winding *K* is connected, as the initial current passes through the stage shown by *AB* in Fig. 4, the increased magnetization of core *N* amounts to practically nothing. This is because the core is already saturated by the auxiliary direct current and also because the winding of *P* is such as to make it tend to add to the already saturated flux. In *N'*, however, due to the fact that winding *K'* is in the reversed direction to that of *K* the current in *P'* tends to decrease the total flux in the core *N'*. This can readily be done, and as the flux diminishes in strength, the change in flux induces an electromotive force in

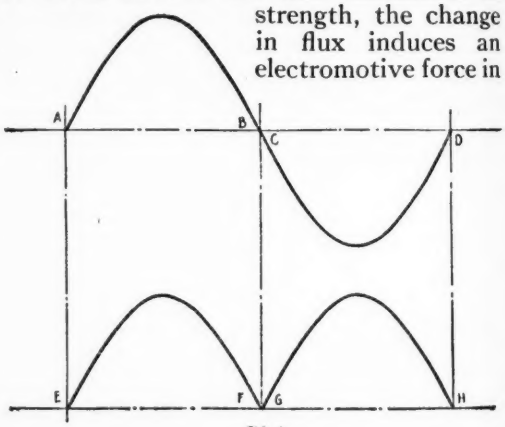


FIG. 4

Curve showing how the first transformer makes the original current uni-directional

the secondary winding *S'*. The result is the secondary current roughly represented by *EF* in Fig. 4. As the initial current reverses in direction, as shown by *CD* in the same illustration, it is evident that the phenomena in the core *N* and *N'* are

reversed also, that is *A* the flux in core *N* is diminished and an electromotive force is induced in the secondary windings *S*, while the flux in core *N'* remains practically the same and no E. M. F. is induced in the winding *S'*. Due now to the manner in which the secondaries are connected together, the last induced E. M. F. produces a current through the secondary circuit in the same direction as that produced by the first E. M. F., giving the current represented by *GH*. As this is repeated over and over again, many times in a second, the secondary current obtained goes through twice as many cycles as the initial current and it is therefore of twice the frequency of the initial current.

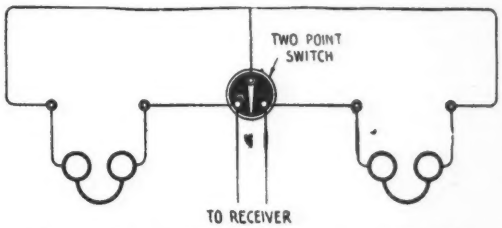
The new current is now led into an exactly similar transformer and its frequency is again doubled, giving a current which is now of a frequency four times that of the initial current. In the Arco-Joly system as used at Sayville, Long Island, the generator supplied a frequency of about 8,000 cycles per second, so that the frequency of the current supplied to the antenna was 32,000, which corresponded to a 9,400 meter wavelength. The electrical and magnetic losses were kept down by making the cores of very thin iron sheets, which were insulated from each other, and by making the windings and connecting wires of separate strands, some 2,000 in number, two-hundredths of a millimeter in diameter, and each one insulated from the other. The power sent through the coils amounted to over a hundred horsepower, so that to keep them from burning up they were immersed in tanks of circulating oil. The generator itself was water cooled.

Loading Coil in Series with the Secondary

WHEN a low resistance detector is used, it is a good plan to tune the secondary circuit by using a comparatively small inductance coil and a large condenser, for then the current flow is at maximum and the voltage is quite low. For high resistance detectors the reverse is true. Increased efficiency with such detectors as the audion can frequently be secured by inserting a loading coil in series with the secondary, and correspondingly reducing the capacity of the tuning condenser. This applies the highest possible voltage to the grid.

Double Set of Receivers to Amuse Visitors

THE amateur who is continually having visitors will find two sets of binding posts for the telephones very handy. These can be best placed one pair at each



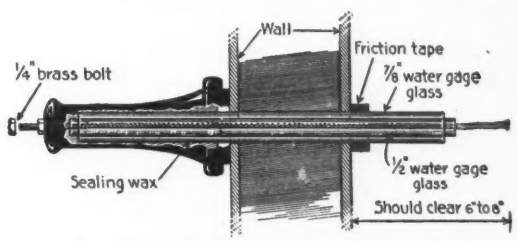
Two pairs of binding posts on each side of the receiving set for an extra telephone

side of the receiving set. A two-point wood base switch, connected as shown in the illustration, will short-circuit either pair of telephones or leave both in circuit.—HARRY N. BLISS.

A High Voltage Lead-In Insulator Tube

THE leading-in insulator described is cheap and effective, and will withstand the voltage of an ordinary 2 kw. transmitter. It is made from a hard rubber or composition telephone-receiver shell and two water-gage tubes.

A 2 by ¼-in. brass bolt is run through the cord-hole in the receiver-shell, after having soldered to its head some twenty strands of No. 20 or 22 copper wire, long enough to reach through the gage-glasses. The tubes are placed one over the other and

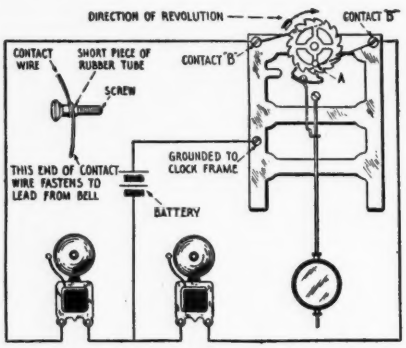


Two water glass gages carrying a high voltage lead-in wire run through a wall

the wires run through; then the glasses are cast into the receiver-shell with sealing wax. A hole is drilled through the wall and the tubes slipped through and fastened with friction-tape. The water glass tubes are long enough to receive the rubber part of a telephone receiver on the inside for appearance.—D. R. SIMMONS.

Making Your Window Tappers Tap Intermittently

AS a contrivance for attracting attention to window displays, the electric window tapper has lost some of its former value, simply because people have become so used to its buzzing sound on the glass that they will not stop to look. The device can be restored to its former usefulness, however, by a very simple expedient. Secure an ordinary clock and around a spoke on one of its gearwheels twist a piece of wire in such a way that the loose ends project outward from the face of the wheel and form a pin *A*. This pin can be made to engage two or more contact wires at every revolution of the wheel. Thus an automatic circuit breaker is formed. This circuit-breaker, when introduced into the wiring of the window tapper in the manner shown in the illustration, will cause the tapper to buzz at intermittent, and to an observer going past the window, unexpected intervals.



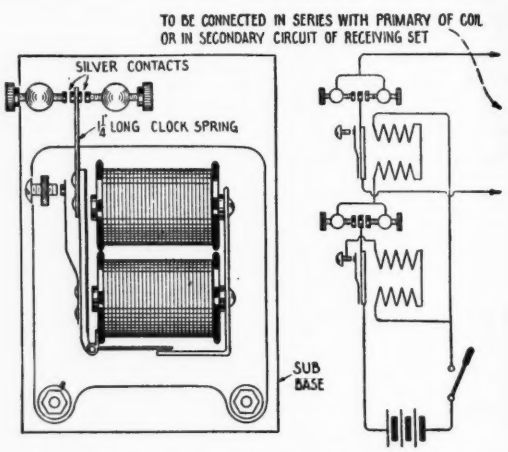
Wiring diagram to an old clock for making an intermittent current

Two or more tappers, as the illustration shows, can be attached to the same circuit breaker, simply by mounting the corresponding number of contact wires in such position that the pin on the gearwheel can touch them in its revolving. The tappers, when placed in unexpected parts of the window, rarely fail to make a marked impression on a passer-by. As can be observed by studying the wiring, the pin on the gearwheel in revolving connects with first one of the contact wires, then the other. This causes the two tappers to buzz alternately, and for a short time only, instead of steadily, as is ordinarily the case. To a passer-by, the resulting sounds are as if a Hallowe'en "tick-tack" had suddenly gone off, and he stops to see what caused the commotion. By that time, however, the sound has ceased. But just as he is about to move on, the other tapper comes into action in some other quarter of the window with its own "tick-tack"—this due to the fact that the pin on the clock wheel has in the interval proceeded far enough to engage the other contact wire. Again the passer-by halts. In such manner the contrivance works all day long, focussing the attention of the passing crowds.

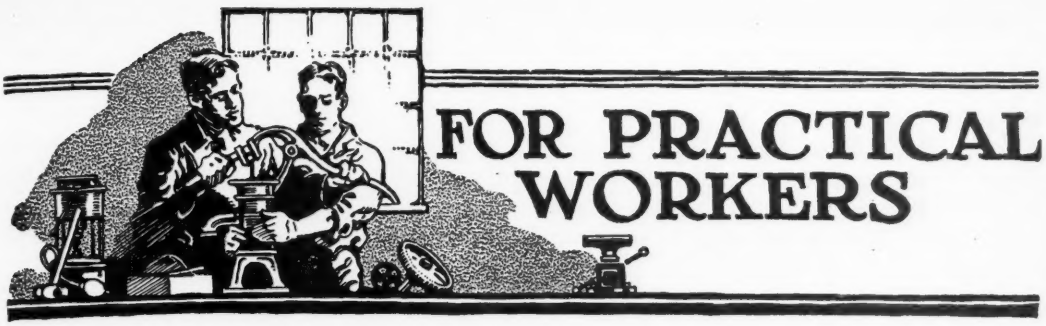
In the drawing below the two contact wires *B* are shown mounted on the corner screws of the clock frame. To do this it is first necessary to envelop the heads of the screws and a small part of their length with short bits of rubber tubing. The contact wires are twisted tight to this rubber tubing, the latter thus insulating them from the screws. If the contact wires were not insulated in this way they would make direct connection through the clock frame to the wire attached to its bottom post and thus keep the tappers buzzing steadily—which is not desired. The only precaution necessary in erecting this apparatus is to see that the contact wires are insulated from the frame of the clock.—LLOYD E. DARLING.

A Vibrating Ticker Interrupter Made Out of a Buzzer

A BUZZER, modified as shown in the illustration, may be used as a "ticker" or "chopper" for receiving undamped wireless waves, or as an independent interrupter for small spark-coils. The instrument can be constructed from one or two ordinary buzzers (depending on the frequency required). When it is to be used as an interrupter it should be fitted with large contacts and a suitable condenser.—WERNER STAAF.

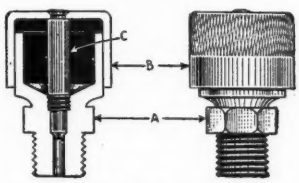

TO BE CONNECTED IN SERIES WITH PRIMARY OF COIL OR IN SECONDARY CIRCUIT OF RECEIVING SET
SILVER CONTACTS
1½" LONG CLOCK SPRING
SUB BASE

Two vibrators or buzzers may be combined to give a multiplied vibration frequency



Dust Proofing the Priming Cup on Automobile Engines

AS motorists well know, the presence of small particles of grit and dust in the cylinders of an automobile motor causes much trouble. Unfortunately most priming cups are the source of this trouble. They collect dust which is washed into the cylinder when priming the motor. Herewith is shown a cup designed to prevent such trouble. It consists of a brass body *A* threaded on the end so that it can be screwed into the cylinder. Just below the small tapped hole in the body is a conical seat for the needle-valve *C*, which is made of steel. The upper end of the needle-valve is riveted into the cap *B*, which is knurled on the outside so as to present a good gripping surface. The needle-valve is seated by screwing down on the knurled cap.—W. BURR BENNETT.



Cap for the cup with needle-valve

Proper Care of Inner Tubes to Prevent Chafing

IF tire users better understood the construction of inner tubes, and factors which contribute to their wearing out, it would be easy to secure more and better service. Spare tubes should not be carried in the cardboard boxes furnished from the dealers' shelves. There is much danger of their being chafed. Tube bags can be secured for this purpose.

If the car is equipped with smaller tires on the front wheels than on the rear wheels, an extra tube should be secured for each size. The cross-sections of inner tubes are made a little smaller than the normal air space inside of the cases. It is not advisable to use a 4½-in. tube in a 4-in. case. This usually wrinkles and creases the rubber, with bad results. Do not use a 4-in. tube in a 4½-in. case for any length of time. When this is done the rubber is stretched too much and the effect of heat and displacement of air in the tire quickly uses up the life of the tube.

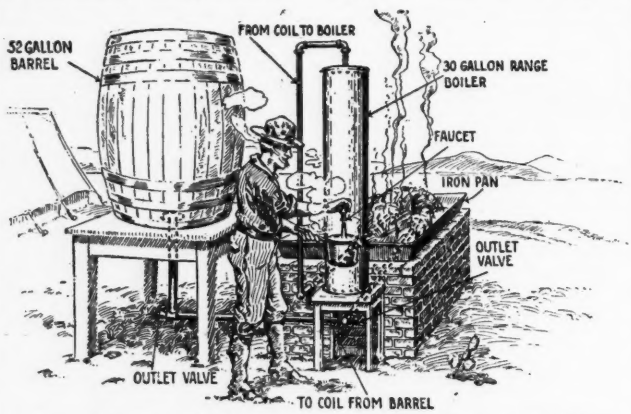
If put into usage for which it was not designed, the tube will not, as a usual thing, render efficient service. If it were practical to use one size of tube in another size of case, tire manufacturers could effect a big saving in equipment and furnish only a few sizes of tubes.

Lubrication is most important to conservation of the tube, but it is a matter that is given the least attention. Practically all tire manufacturers treat the inside of cases with a white solution to prevent tubes from sticking to the adhesive "friction" of the fabric. A good lubricant, however, should also be used.

Some tire users neglect dusting soapstone inside of the case when changing a tube. Others use the soapstone so sparingly that it does but little, if any good, or they may use so much that it does more harm than good. If a quantity of it be dumped into the case it will collect at one point, and during the hot weather will heat up to such extent as to burn the rubber of the tube, making it thin, brittle and lifeless. This results in a honeycombed appearance. Soapstone is the lubricant most used for tires and is satisfactory, but not lasting. Therefore, a fresh supply should be put in the tires at least two or three times during the season. Powdered mica has proven a more durable lubricant than soapstone, and quite as effective as graphite, and is much more pleasant to handle. It should be dusted on the fabric all around the case and on the inner tube to cover every particle of the surface.

Bath Water Supply System for an Army Camp

WHEN the cold days of early winter set in the army boys on the Border began devising ways and means of heating water for the bath. In many camps different devices were to be seen, but the one that appealed to me most was a barrel used as a tank, with a coil of pipe connected with it for a water heater. The barrel was placed on a table to make its lower end considerably above the furnace top. A pipe was led from the bottom of the barrel down to a tee joint, then horizontally to the end of the furnace, where another tee was used to make connections for the coil in the furnace fireplace. The opposite end of the pipe-coil was connected with the pipe system from the top end of a range boiler set on another small table to bring its lower end above the fireplace coil. The barrel supplied the water to the tank as it was drawn out through the faucet. The furnace in this case was the incinerator, which was kept burning at all times. Consequently there was hot water ready for shaving and washing, as long as the barrel was kept filled. This is a simple way of solving a hard problem and can be readily adapted for use in small camps.—GEORGE M. PETERSEN.



A range boiler and a barrel with pipe connections for heating water from an incinerator fire to supply hot water for baths

The Right Meaning of the Term Reaming

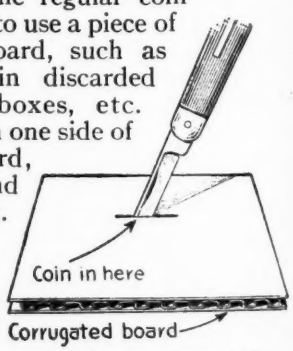
EVERY machinist knows what it is to be asked to "ream" out a hole a little larger,—"little" varying from a few thousandths of an inch to ½ in. As a matter of fact the lay public knows very little about reaming. The truth is this: Holes for reaming are drilled from .003 to 1/64 in. smaller than the final size. Then a reamer is used to bring the hole up to the exact size, round and true, which cannot be obtained with a drill alone. More than this amount cannot be taken out with any ordinary reamer for metal. Not only is this true, but the construction of a reamer prohibits it from even starting in a hole any smaller, as the end is only 1/64 in. smaller than the final size.

Reamers do not cut oversize. Thus, if a hole is reamed to ¾ in. and a shaft is tight in it, the opening cannot be enlarged a trifle, or "reamed out a little so that the shaft is loose." Stock reamers are made in sizes varying by sixteenths. Any size between must be made to order. Expansion reamers are not made in sizes under ¾ in. The reason for this construction is to allow the teeth to be sharpened and "set out" again to the original size. They are seldom found in small shops and do not enter into the case in the every day request to "ream it out a little."

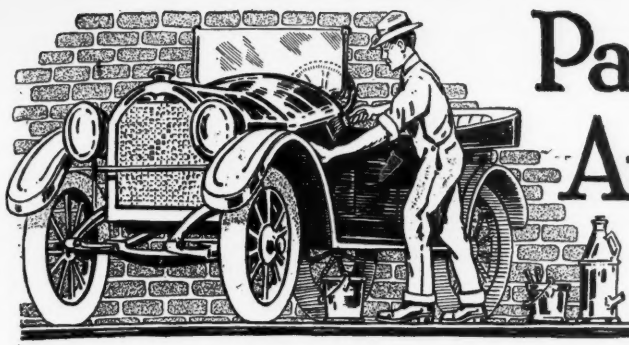
Remember a hole can be enlarged not more than 1/64 in. by a reamer and not even that much unless the hole happens to be that 1/64-in. under a standard size in sixteenths.

A Handy Method of Sending Small Coin by Mail

A SAFE and handy method of inclosing small coins in letters, if you do not happen to have the regular coin holder at hand, is to use a piece of corrugated cardboard, such as may be found in discarded wrappings, egg-boxes, etc. Simply cut a slit in one side of the corrugated board, push the coin in and press it down flat. Be sure to write on the outside of the cardboard, "Coin in here" or "Money inside the card," so that the receiver can readily find the coin between the sides.—ALBERT B. WEGENER.



Slitting a corrugated board to hold coin



Painting the Automobile

By James M. Kane

THE enjoyment of that "did it myself" feeling, quite as much as economic reasons, impels the automobile owner to paint or refinish his own car. The time-saving, ready-mixed preparations—full directions on each package—now in the market, will aid him greatly. By purchasing advertised materials, put up by reliable manufacturers, he can, if he follows the directions carefully, look forward to a satisfactory termination of the work. A few coats of material carefully put on and allowed to dry out thoroughly will look better and give better wear than a dozen coatings carelessly applied.

If the car is in such bad shape that all the old coatings must be removed down to the wood or metal, procure a can of paint remover, and use as directed. After all the old coatings are removed, wash the car with gasoline to remove all traces of the paint remover, then smooth the surface with No. 0 sandpaper, and clean out all rust spots, cracks and depressions with emery or sandpaper. Dust off and apply the priming-coat and proceed as in refinishing.

Presuming that the car is to be finished in black, which is the safest, and at the present time the most popular, purchase the following materials:

1—1 lb. can of coach black-ground in Japan
1—1 lb. can of white lead
1 can of (black) color and varnish, mixed
1 tube of oil color for lettering and striping
1 quart of turpentine
½ pint linseed oil
½ pint Japan drier
1 quart rubbing varnish
1 quart finishing varnish
½ lb. ground pumice stone
1 putty knife
1 felt rubbing pad, made from old felt hat
1 can patent crack filler
¼ lb. whiting
½ doz. sheets No. 0 sandpaper for rough work
½ doz. sheets No. 00 sandpaper for fine work
1—2½-in. flat brush for color
1—¾ or ½-in. flat brush for color
1—2½-in. flat, chisel shape, varnish brush
1—¾ or ½-in., chisel shape, varnish brush
1 or 2 camel's hair stripers—fine
1 camel's hair, or sable lettering brush, small

The large brushes are for the board surfaces, and the small brushes for the edges, moldings, etc.

The whiting and Japan drier will be necessary to make hard putty, but unless the depressions are deep, use the patent crack-filler exclusively.

Add enough black color to the putty so that it will match the gray color of the priming coat. Putty is made of whiting, raw linseed oil and Japan. A good putty can be made of dry white lead mixed in equal quantities of coach Japan and rubbing varnish, which is reduced with turpentine if necessary. Whiting is designated in the list of materials, but if the last mentioned recipe is used a small quantity of dry white lead can be used instead of whiting.

Tell your dealer what you want the materials for. He may be able to give you some valuable information regarding new preparations.

Painting Room

Select a clean, well lighted place in which to paint the car. A room that can be heated, if necessary, is best. Jack the car up on 4 strong boxes or trestles. Arrange them far enough away from the wheels to give you room to work on the inner sides of wheels. Do not remove the wheels as the bearings may drop out, and they are hard to replace.

Wash off all the mud you can with a hose. Scrape off all greasy mud and grease, with a scraper or putty knife. Take a stiff brush, dip it in gasoline, and loosen up what remains in the crevices and on the surface. Clean out the brush and give a final scrubbing with clean gasoline to remove all traces of grease and greasy mud.

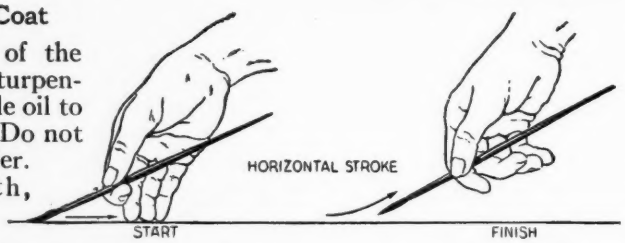
A sponge saturated with clean gasoline will be handy in the work.

For your priming coat, mix the white lead with turpentine, adding a little oil and Japan drier. Add enough of the coach black to color it a dark gray. Apply this evenly to the surface, dusting it off first, just before painting.

When this coat is thoroughly dry, fill up the cracks and depressions with the crack filler, or putty, allowing the filler to project a trifle above the surface, as this permits the filling to be cut down level with the painted surface. Now smooth the surface all over carefully with No. 00 sandpaper. Some painters use the crack-filler mentioned as another coat painted all over the surface. Then it is smoothed with sandpaper. This is easily accomplished because of its hard drying qualities.

Black Color Coat

Mix up some of the flat-black with turpentine, adding a little oil to act as a binder. Do not add any Japan drier. Apply a smooth, even coat of this, and let it dry.



After this, lay on a coat of black color and rubbing varnish mixed. Use the ready mixed article, rather than your own mixture of black coach color, rubbing varnish and a little turpentine. When the color and varnish coat is dry, rub it down even with pumice stone and felt pad. Do not use sandpaper, as the succeeding rubbings are to be done with the pumice stone.

Methods of holding brush for striping

Wet the felt pad, dip it in the pumice and shake off the surplus powder; then go over the work with an even circular motion on the large spaces. Rub in straight lines along the edges of the doors, panels and on the molding. When the surface is cut down evenly, wash off the pumice, dry, and apply a coat of clear rubbing varnish. Let this dry and then rub down with pumice stone as before. Wash the surface thoroughly and when dry, put on the striping and letters. A carmine, or dark red stripe looks well on a black surface. The object of all this rubbing down is to secure a perfectly even surface before applying coat of finishing varnish.

During the progress of the work you may notice that the surface is slightly unlevel here and there, but as coat after coat is applied and rubbed down, these places will gradually come up to the level, and when the finishing varnish is applied the surface will be smooth and glistening; that is, if the work has been done carefully and plenty of time given each coat to dry before resuming the work on it.

Sandpapering

Sandpapering must not be attempted if the surface is not thoroughly dry. The loosened material should fly off like dust during the operation. If it clings to the sandpaper in spots and cakes, the surface has not dried out. Give it a day or more to dry out before going at it again. The same advice holds good for the rubbing down with the pumice. No dust will fly, as the pad must be kept wet, but the surface should be just as hard as for sandpapering. During the pumicing, wash off the surface with a wet sponge to remove the abraded material, as well as to see how the work is proceeding.

Striping adds a distinctive appearance to any car, but its application requires the skill, the accurate eye and steady hand of the expert. Poor striping is an irritant to the eye. The proper and only stripe on a pleasure car is a thin, hair-line ½ or ¾ in. away from the edges or moldings of doors and panels. This stripe should follow the lines of the doors and panels. Sometimes the curves of the mudguards, and those of the hood are also striped in the same way. All automobile wheels are not striped alike. Examine the striping on various wheels and follow the style that pleases you best. Actually, the stripe is a contour line—sectional or continuous.

To stripe, take a clean, flat piece of glass or tin, place a small quantity of the tube color upon it and thin to working consistency with a little turpentine. Then take the striper and draw it through the color to load it. Draw it toward you several times on the clean surface of the glass or tin,

so as to wipe off the excess color. In doing this you will notice just when there is enough color in the brush to make a stripe of even density. If the brush is too full, the stripe will thicken and spread at the edges.

Take the brush between the thumb and forefinger, with the thumb uppermost. Now place the point of the brush on the exact spot where your stripe starts, and with the fingers resting lightly against some convenient parallel surface, draw the hand backward with a quick easy movement, to produce the stripe. The fingers act as a gage and a movable rest. Don't make the stripe in short, jerky sections, or it will look patchy. Make it in one, quick, uniform stroke.

If there were no curves to be turned, the amateur striper might do a passable job with a fine sable, or camel's hair brush and a straight edge, having a padded projection at each end of the straight edge to raise it off the surface of the car. But since the curves on an auto are numerous the striping had best be omitted, since faulty work will surely take all the shine off an otherwise well finished piece of painting.

Lettering

Put on the initial letters about ½ in. high, with the same tube color you have used in striping; or you can vary the color if you wish the letters to contrast more or less. The small-sized letters, like the ½-in. size, seem to be much preferred to those of greater height.

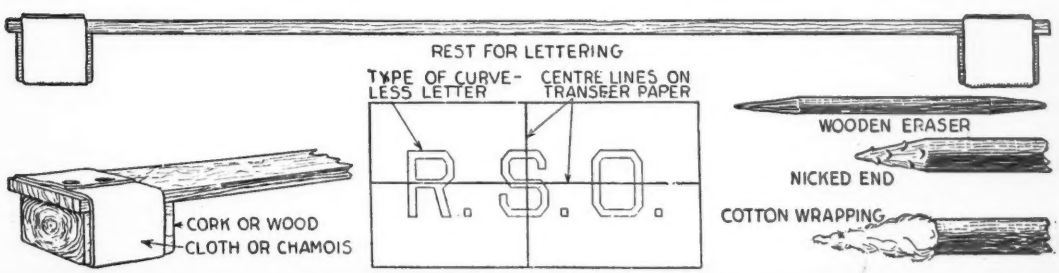
Outlines of letters, or monograms may be transferred to the surface as follows:

After having drawn or traced the letters, or monogram, on a clean sheet of paper, in the precise shape you wish them to appear on the door or panel, rub the reverse side of the sheet with a piece of chalk, dusting off the excess chalk. Place the paper on the proper spot and holding it firmly, go over the lines of the letters, or monogram with a pencil point, or a pointed piece of wood. Upon removing the paper, the letters will be seen in white chalk lines wherever your pencil point has pressed upon the paper.

Before transferring the letters, cut the paper to a convenient size so that it can be handled easily. Also draw two lines at right angles upon it for the purpose of centering on a chalk dot you have placed on the door, or panel. Be sure you have gone carefully over all the lines of the letters before removing the paper. By holding the paper firmly in position, you can turn up the edges and see whether you have missed a line or a letter. Do not bother about cleaning off any chalk-marks until the letters are dry. These marks can be easily sponged off before varnishing.

If you cannot turn neat curves in lettering, do not attempt letters of the curved type. Rule the letters up as though you were forming them with a pen and ruler. If you happen to draw an incorrect line either in striping or lettering, wipe it out quickly with a lump of absorbent cotton slightly damped with turpentine. Dry with a clean piece of cotton, and be more painstaking in replacing the line or letter correctly.

If the line be difficult to erase because of its being close to other lines, do not use the lump of cotton, for fear of blurring or smudging the correct lines. Take a piece of soft pine the length and thickness of a lead pencil. Whittle both its ends into pencil-like points, nicking them on their sides so as to raise a little of the wood. These nicks will prevent the cotton from slipping off. Wrap a clean piece of cotton around each end, forming each piece into a blunt, pencil-like point. Use one end of this eraser, dampened with turpentine for removing faulty lines or spots. Use the



A straight edge with padded ends is used for guiding the striping brush. Forms of a curveless letter for initials and erasers are made of nicked sticks and cotton covered ends

other end dry for finishing the erasure. Use a clean piece of cotton each time you have occasion to remove any paint.

Varnish is not applied merely for the purpose of securing a highly polished surface, but also as a protection to the underlying coats of color.

Have your paint shop clean before you start varnishing. Allow no open doors, or cracks to conduct a dust laden current of air against the freshly varnished surface.

Let the heat of the shop and that of the varnish be the same, say about 70 degrees. Never have it cold.

After having dusted off the car take the large varnish brush (2½ in.) and put the varnish on, but not too thick. Do not fill your brush so heavily that the varnish will run down the handle while you are working. Just put enough paint on the brush to go over the space easily, and never work all the varnish out of the brush before taking up a fresh brushful.

Putting on the initials of the owner's name in the center of the front automobile door

Do not tickle the surface with short strokes; but brush easily from one side to the other, and then up and down. This is called cross-brushing, and gives uniform depth to the coat, which is just what you want to secure. For all surfaces that cannot be conveniently coated with the big brush, use the ¾-in. brush. Varnish the moldings or raised portions around the panels the same way in which they run; that is, follow their lines along or around the surfaces they enclose. You can run across them with the big brush, but always finish with the small brush in the way described.

Always finish one section first, if possible. Take a door or a panel and complete it before going on to the next one. Pick out the small areas first and by the time you tackle a big stretch you will have more confidence to handle it.

As you go along, take up any varnish that has run or shows a tendency to gather thickly at the edges of the panels, etc. Never miss any spot, however small. If you do, you will just naturally try to patch it, (after the rest of the surface has set) and botch the whole job.

In varnishing the wheels, be careful to keep the varnish from running down the spokes and settling thickly between them where they enter the hub. After varnishing the rim, spin the wheel easily, holding the brush lightly against it to smooth out and join the laps on the rim. Finish the hub in the same manner.

When the job looks right, surfaces evenly covered, no thick places at the edges, and all places coated, put your brush away and leave the car alone.

Stand the hood cover on its edge so that the dropping dust will not fall on it. Lay a board supported on two trestles over the mudguards for the same purpose, or use an adjustable shield.

Allow plenty of time for the last coat of varnish to dry. Let it stand for two or three days at least. When thoroughly dry, wash it with clean, cold water, dry with a soft chamois and the car is ready for use. You may possibly have some trouble in mixing your priming coat. Better mix it a day or two before you begin work. This will give you a chance to try it on the surface, for drying and hardening qualities. Don't get it thick. It may need a little more Japan to harden it or turpentine to thin it out, but it will not require any additional oil. Keep it in a tightly topped can, and it will be all right when needed.

Good coach putty should dry hard, and stand sandpapering without scaling or softening. One authority suggests a putty composed of 3 parts whiting and raw linseed oil mixed with 1 part white lead. A little Japan should be added to harden it. This putty must be stiff and well worked up. Another prescription calls for a mix-

ture of dry white-lead mixed with varnish, Japan being added as a hardener. The safest plan is to buy all the materials ready mixed—if possible.

Clean the paint brushes in gasoline and the varnish brushes in clean turpentine. Wash out with warm water and soap, and they will be in good shape no matter how long they are laid away.

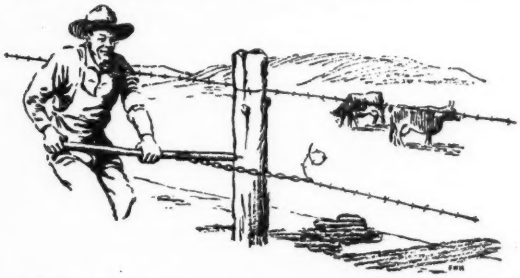
Fastening Nails So They May Be Quickly Withdrawn

WHEN nailing a box, such as a form for cement where it is necessary that the contents should not be marred or injured, put under each nail-head a small piece of lath or other bit of wood. When removing the nails split away the small piece of wood and enough of the nail head will be exposed for easy drawing.—LINDALL WILLIAMS.

An Emergency Wire Stretcher for Repairing a Fence

AFTER turning the cows into a field I happened to find a broken place in the fence and I did not have the time to go for a stretcher at the other end of the farm. Finding a hickory stick in the wood pile I sawed off a piece about 3 ft. long for the handle. I could not take the time to prepare a fire for heating an iron so I flattened the end of a ¼-in. bolt and drove it in one end of the stick, then beat the head to make it rough like teeth.

Several inches from the end I fastened a short length of chain and a hook taken from a singletree. The hook was bent



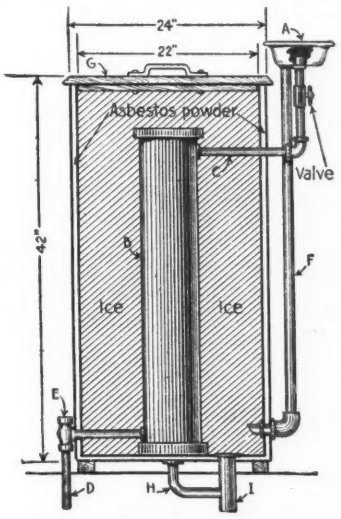
The bolt end of the homemade lever is placed on the post for stretching a fence wire

so that the barbs on the wire could not slip through.

When barbed wire becomes slack it can be tightened by catching it between the claws of a hammer and making a series of kinks. These kinks should not be too short to weaken the wire.—J. L. PINKSTON.

A Bubbling Drinking Fountain with Icing Reservoir

THE bubbling fountain shown in the illustration was made by a workman in a large institution at a cost of $8.75 for the material, to replace an expensive one that had become useless. The body is made square of heavy galvanized iron. There are two boxes of the size shown, the space between them being filled with powdered asbestos. An ordinary bubbling cup *A* with its valve is connected with the upper part of the water reservoir *B*. The pipes, *C* and *D*, are the ordinary ½ in. galvanized kind. The supply comes through the pipe *D* where it enters a 2-in. galvanized pipe *B* used for the reservoir. A key tap is placed in the line *D* for regulating the flow. A waste pipe *F* is attached, as shown, to keep the cup *C* free from water. The cover *G* can be lifted and enough ice put in to last from 5 to 7 days, according to the quantity of water used. A small drip between the boxes is shown at *H*, while the waste to the sewer is shown at *I*. The tank is elevated on four blocks for air to pass below it.—JAMES E. NOBLE.



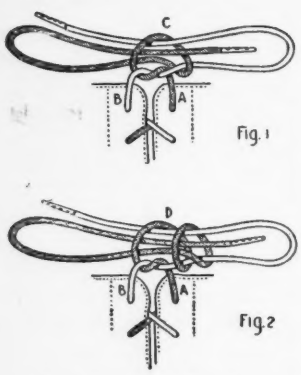
Ice-water tank with bubbling fountain attached

A Hat Hook or Holder Made of a Lead Pencil

IF you can't find a hook to hang your hat on and wish to furnish some amusement quickly take an ordinary pencil, find a smooth board surface, and place the pencil flatly against the surface, holding it lengthwise. Briskly rub it up and down for a few times and it will immediately adhere without any danger of falling off. A hat can be hung on it providing the headgear is not too heavy. The "impromptu hook" will remain in this position until removed. —CLARENCE T. HUBBARD.

A Tie for a Shoe Lace That Will Stay Tied

IT is not always the large things that annoy us most as a persistent vexation. By this is meant that when some important thing annoys us, we immediately set about correcting the trouble, but a small thing—too trifling to bother with—will worry us repeatedly and we give it no attention. A very good example of this petty annoyance is shoe laces. Many times a day do we see people stop by the wayside and tie their shoe laces. Especially is this true with new laces.

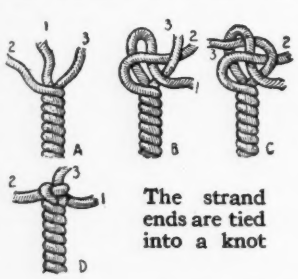


Two turns in shoe lace tie will hold it tightly

One extra turn of the lace about the first loop made will produce a secure fastening even if not drawn absolutely tight. The ordinary bow-knot used to fasten shoe laces is shown in Fig. 1. The string *A* is given one turn about the string *B* at *C*, before the loop of string *A* is passed through. By making two wraps as shown in Fig. 2, at *D*, before passing the loop in string *A* through, a fastening is made that will not slip or shake loose. It is so simple that it is strange that you have never found it out before, but it does the trick and holds tightly.—GEO. S. BROWN.

Keeping the Strands of a Rope End from Unraveling

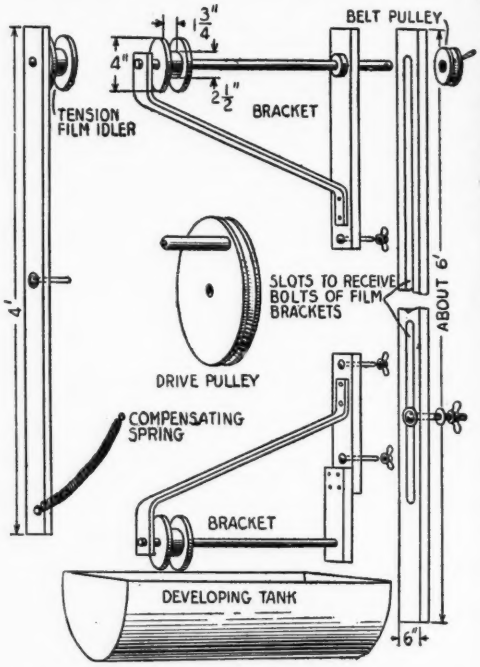
THE three strands of the rope are separated as shown at *A*, then the strand marked 1 is turned over between 2 and 3, then 2 is turned over on 1 and between the base of 1 and 3, as in *B*. The end of the strand 3 is then run through the loop of 1 as in *C* and drawn up tightly as in *D*. The strands are then cut off close to the knot.—TUDOR JENKS.



The strand ends are tied into a knot

Saving Chemicals by Machine Development of Film

THE amateur who undertakes to develop his own moving picture films finds many difficulties, which, to say the least, are discouraging. The films are long and unwieldy unless wound on drums or racks, nor can they be handled after being wet. If the drum system is used the space required for operation is prohibitively large for most amateurs. If the tank process is used there must be at least three tanks, one each for the developing, fixing and washing solutions; and the space necessary for their installations, as well as the cost of the tanks themselves, puts it beyond the reach of the amateur at home.

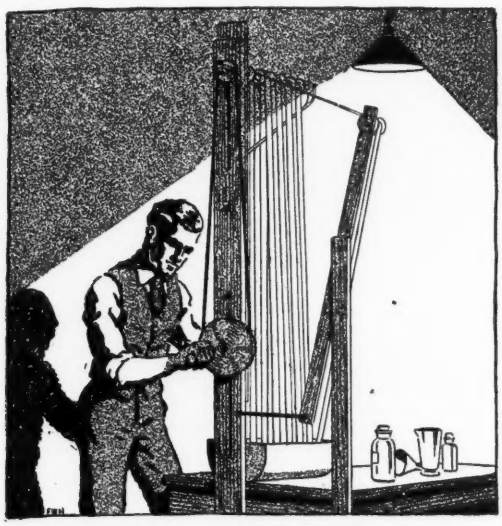


The upright and its attachments for driving moving picture film through the chemicals

In addition to the space required for the tank system, about 35 gal. of developer will be necessary to fill a tank that will handle 200 ft. of film. At the present price of chemicals this would cost about $20, and as it deteriorates rapidly whether it is used or not the development is rather expensive for a single film.

The experimental engineer for a moving picture concern in the west was forced by the limited size of his laboratory to install a developing, fixing, washing and drying apparatus for moving picture films, which

is simple, efficient, inexpensive and small. A small commercial house could, in some cases, use the plan to advantage. The outfit can be placed on the wall of the dark room in an unused corner. Made in



This method of development economizes in chemicals, as a very small quantity is required

approximately the dimensions shown, which may be varied to suit the conditions, it will accommodate from 10 to 100 ft. of film and it will use less than 1 quart of developer per 100 ft. of film.

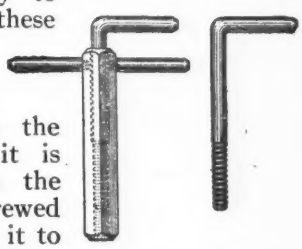
The film to be developed is wound around the rollers as if it were a belt, with the emulsion side out. The upper bracket carrying one of the multiple rollers is adjustable for different lengths of film, so that the single idler will serve to compensate for the slight variation in the film length during developing and drying. When adjusted properly the ends of the film are spliced together, thus making a continuous belt. The upper set of rollers consists of a flanged stick on a shaft equipped with a grooved pulley so arranged that it can be belted to a motor or, in the absence of a motor, to another wheel placed conveniently and fixed in a way to enable the operator to run the apparatus by hand.

The developing pan or tray is preferably an enameled baking pan which can be partially filled with either developer, water or hypo solution and raised underneath the bottom set of rollers so as to immerse the running film into the several liquids as desired. The film can be stopped and examined at any time and the solutions changed in a few moments, especially if the operator has a pan for each solution. After development, fixing and washing, the film may be quickly dried by running it over the rollers while the air from a fan is turned on it, provided the room is free from dust, which is essential for all the work.

In setting the apparatus for any length of film it can be marked on a scale for future use, or by the use of a tape line the device can be calibrated and marked so the rollers may be set at once and properly for any length of film. The entire apparatus should be painted with paraffin dissolved in gasoline to prevent the wood from wetting and swelling, and to prevent the absorption of fluids by the unprotected parts of the frame.—T. B. LAMBERT.

A Driver to Turn Studs in Aluminum Castings

METAL workers who attempt to put studs into aluminum castings usually do the job with tools not intended for the work. A very handy tool may be made for this work, as shown in the illustration. It will be necessary to have a set of these tools, one for each size stud used. The stud is screwed into the tool as far as it is necessary; then the center piece is screwed down tight upon it to hold the stud in place. The stud may be driven tight into the casting and the center piece loosened; then the tool may be turned off from the stud with perfect ease, leaving the stud set. The shank of the tool is made of hexagon stock and the center piece of $\frac{3}{8}$-in. round machine steel.—THERON L. WINCHIP.



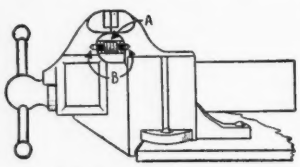
A driver to turn studs in aluminum

A Lasting Paint for Covering a Heated Surface

A GOOD black, heat-resisting paint for the front of a locomotive, or other place subject to heat, can be made in the following manner: Shave 6 pounds of brown soap and melt it in water, then add more water to make it up to 12 gal. Mix in 18 gal. of Japan oil, then stir in 80 lb. of the best graphite. This will make about 35 gal. of paint. Stir the mass well and apply while the object is not too hot.

Keeping Vise Jaws Open with a Coil Spring

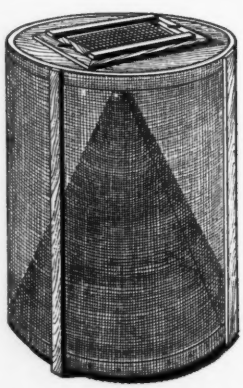
EVERY mechanic knows what it is to work with an old vise where the screw and nut are so badly worn that it becomes necessary to back the movable jaw farther than necessary when inserting the work. The trouble caused by this back lash can be eliminated by the spring shown in the illustration. The spring *A* is inserted between the two jaws and kept in place by two plugs *B*, which are driven into holes drilled in the jaws. It is evident that, as the handle is turned backward, the movable jaw will follow because of the spring pressure, thus eliminating all loss of motion. There is only one objection to this; that is, it fills up the space between the jaws. When necessary the spring may be easily removed.—W. BURR BENNETT.



Spring in vise jaws to hold them apart

Making Large Fly Traps for Packing Houses

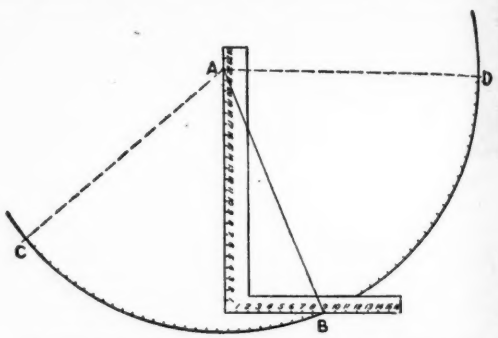
GETTING rid of flies in packing houses is one of the problems which has engaged the attention of the Bureau of Entomology in cooperation with the Bureau of Animal Industry of the Department of Agriculture. An extensive investigation of the various types of fly traps used at the establishments where Federal meat inspection is maintained has been made. While there has been much variation in the effectiveness of different types of traps, it has been found that the conical trap is most efficient. One type of mechanical trap has been found particularly effective. This trap is 24 in. high, 18 in. in diameter with a cone 22 in. high, by 18 in. in diameter at the base.



A cone within a cylinder, both of screen wire

The frame is constructed of four hoops. Two of these hoops 18 in. in diameter are nailed together. They form the bottom of the frame and the other two the top. The top of the trap may be made of an ordinary barrel end, with the bevel edge trimmed off so that the head will fit closely in the hoops. A 10-in. square is cut out of the center of the top to form a door, the portions of the top being held together by 1-in. strips placed around the opening ½ in. from the edge, to form a jamb for the door. The door is a narrow frame covered with a screen well fitted to the trap.

The top is then nailed to the upper hoops. The outer part of the trap is formed by fastening fine mesh galvanized screen wire to the outside of the hoops. Four light strips are tacked to the hoops on the outside of the trap to act as supports between top and bottom hoops, and the ends are allowed to project at the bottom to form legs. The cone is cut from the screen wire and may be either sewed with wire or soldered where the edges meet. The top of the cone is cut off to give an opening 1 in. in diameter. The cone is then inserted in the trap and tacked to the hoop around the base. The fly trap is now complete.



Laying out a pattern, with an ordinary carpenter's square, for cutting the cone wire mesh

In constructing the cone it is best to cut a pattern from a piece of heavy paper. An ordinary square is placed on the material from which the pattern is cut. A distance equal to the height of the cone is laid off on one leg of the square and a distance equal to one-half the diameter of the base of the cone is laid on the other leg. A line is then drawn between the two points *A*—*B*. In order to figure the distance around the base of a cone of any given diameter, multiply the diameter by 3.1416, or 3 1/7. Cut out the pattern on the curved line from *C* to *D* and on the dotted lines from *A* to *C* and *A* to *D*.

Some Short Cuts to Hasten Work in Sign Painting

THE prime factor in getting out sign work is speed. The expert who is not speedy is not in it. His work may not be perfect, but this is not so much considered if he can hustle it out. There is great competition in this art, or business, and I have known of one of the finest and oldest established shops going under be-

Fig. 1. A scale sketch of letters to be made one foot or more in height from original

cause it could not attain the quick gait. Nor could it come down to doing such work as present day requirements demand.

All this being true, it is surprising that so many will take the longest and most laborious way of doing certain kinds of sign work, that can be done in a far better way. Some think that the expert sign painter has merely to take a survey of the job before him and form in his mind's eye the whole lay-out, without bothering with calculations or measurements. It is doubtful if any sign painter now living could do this. It is perfectly proper to train the eye for this work, for that will enable the workman often to do certain work without taking time to measure or lay it off accurately. A large portion of sign work is done in this way. But he should not rely too much upon the eye alone. For certain large sign work, the "scale sketch" is the thing. It enables one to get all the letters right as to form and space; otherwise there would be some trouble at the end of a line,

Fig. 2. Dividing lines in which an enlarged layout can be made by measurement

say, where letters would either have to be cramped or extended.

Perhaps the most convenient scale is that of 1 in. to 1 ft., giving eight eighths of 1 in., thus representing 1 ft. or 12 in. In Fig. 1 is shown a 12-in. letter in this scale. With this scale you get the proper widths of both vertical and horizontal strokes, and this will be found a great advantage when the lettering is from 2 to 5 ft. in height.

The scale sketch is particularly useful when the sign work is high above the ground, and must be done from a scaffold or ladder; still more especially where the lettering takes a line so long that the swing stage must be moved once or more. Or when done from a ladder which must be moved several times. You simply take the sketch up with you, and set out the letters. Of course, the surface that is to be lettered must be measured and laid off in spaces the size the letters are to be when finished. Then it is simply a matter of reproducing the letters from the scale sketch to the wall. And with two or more copies, two or more painters can work on the letters, each with a certain part of the work to do. Or the workman may begin at the end, or in the middle, anywhere, sure that the work will be perfect.

This laying out of a sign at an altitude may be done where possible by counting the rows of bricks, four to the foot, or if there are no bricks, the width of the sign can be had by measuring along the base

Fig. 3. Large elliptical curves may be drawn by angular lines, then drawn in freehand

of the building, this for making the scale sketch. The width may be laid off on the wall with the rule.

The illustration Fig. 2 is not drawn to a scale, but is intended to show, by its dividing lines, how a man working from a ladder could set out and paint in the letters as he goes along, always measuring from the last upright on the sketch. Get the dimensions as previously suggested, from the ground, etc. The upright lines serve as a guide and the lettering is fancy, not standard. This is a very easy and quick method of lettering, and gives a good appearing sign, too.

Large sweeps or elliptical curves are difficult to form from ladder or stage. An easy way to form such sweeps, as they are called by the workmen, is shown in Fig. 3. The sketch explains itself very clearly.

First draw the angular lines, and then with chalk or charcoal draw the sweep freehand. The angular or straight lines serve as a guide.

Another illustration (Fig. 4) is of the same method, but in this latter case the wooden dividers, which are very large and made for the sign painter's work, will usually be found sufficient for making the circular sweep, and if the sweep is to be elliptical, as it most always is, it may be made freehand, with the compass lines as a guide. The compass would do only for small signs. In Fig. 4 the upright lines serve a useful purpose in dividing the sketch.

Fig. 4. A pair of wood dividers are used to make sweep after drawing the angular lines

Illustration Fig. 5 shows the use of flourish or ornament, sometimes a valuable addition to certain forms of lettering, and these may also be indicated on the scale sketch, getting the form true and just as it is to be when placed, enlarged, on the sign. The value of a beveled bristle fitch, used in connection with a beveled straight edge, is not appreciated as it should be for very large lettering work.—A. ASHMUND KELLEY.

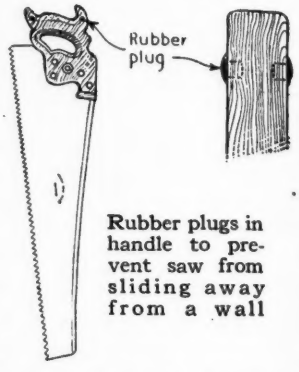
Fig. 5. An ornament added to a sign where it is necessary is laid out from a scale sketch

An Easy Method of Preparing Demar Varnish

TO prepare demar varnish, place from 4 to 10 lb. of the gum in 1 gal. of turpentine, and allow it to dissolve. Agitating it in a churn is the best method. You may also use a mixture of turpentine and benzol, or carbon tetrachloride and benzine, for cutting the gum, but just the pure turpentine is commonly used. The amount of gum used per gallon determines the body or weight of the product.

Rubber Plugs in Handsaw Handle to Prevent Its Falling

WHEN placed against a wall a handsaw has a tendency to slide sideways and fall, often injuring the teeth. This is because the handle horns which touch the wall are smooth and polished, thus offering no frictional resistance. If these horns are provided with soft rubber tips many a fall will be prevented.

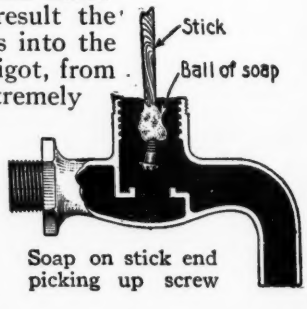


Rubber plugs in handle to prevent saw from sliding away from a wall

To accomplish this, drill a small 1/8 or 3/32-in. hole about 3/8 in. deep in the side of the tip of each horn. Partly fill each hole with rubber cement or mucilage and insert a plug of soft rubber cut from an eraser. Set aside to dry. Have each plug project slightly, as shown. These rubber projections come in contact with the wall when the saw is leaned against it. This prevents the saw from falling down or sliding sideways. The same result may be obtained by winding an elastic band tightly around each horn.—ROY B. SNOW.

Using Ball of Soap to Recover Screw in Spigot

IN the type of spigot where the washer is secured by a screw the constant turning on and off frequently causes the washer to twist, carrying the screw with it. As a result the screw finally falls into the bottom of the spigot, from whence it is extremely difficult to remove it. The usual method is to turn on the water and flow it out, but this is rather uncertain as well as inconvenient at times. I found by fastening a ball of soap on the end of a stick I could remove the screw easily by pushing the device down so that the screw would become imbedded in it. Nuts may be recovered the same way.—JAMES M. KANE.



Soap on stick end picking up screw

Sheet Metal Working Simply Explained

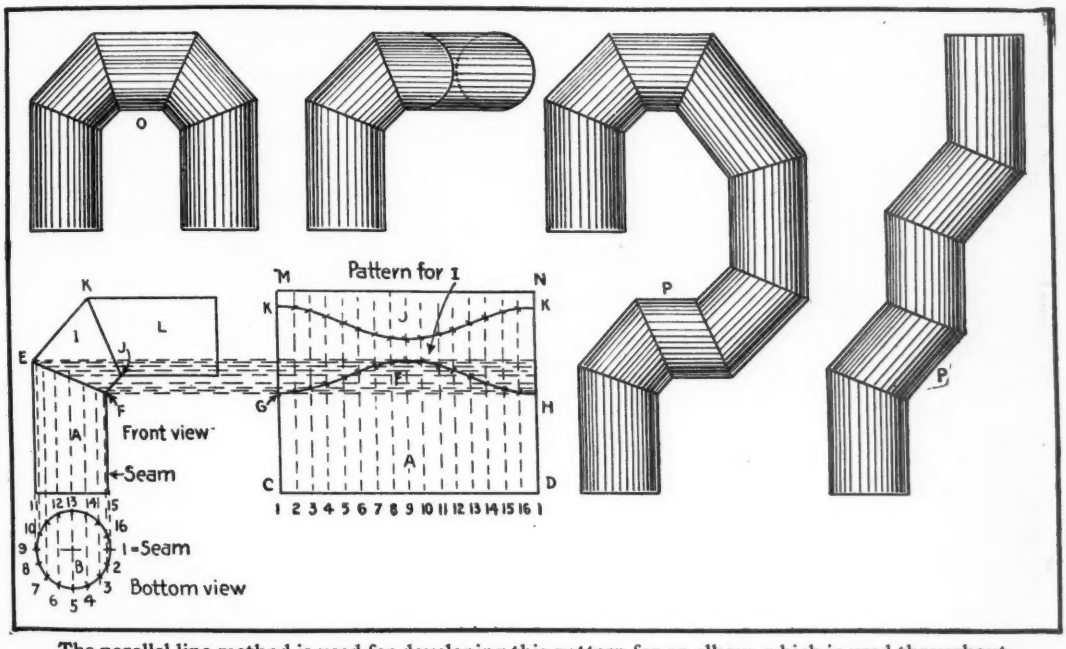
IV.—Development of patterns for three-piece elbow with adaptations

By Arthur F. Payne

Assistant Professor Manual Arts Bradley Polytechnic Institute

AN interesting fact about the developing of a pattern for an elbow is that one piece can be used for any piece of pipe shown in the drawing, and many more combinations are possible.

The method used in developing this pattern is exactly the same as in the "Trench Periscope" and two-piece elbow pattern in the June, 1917, issue, also for the "Scale Scoop" in the July, 1917, issue. It is the method known as the "parallel line," which simply means that the pattern is developed by means of lines parallel to each other. All cylindrical pipe problems are developed by this method. If you will compare the problems in the issues mentioned you will see that this is a fact.



The parallel line method is used for developing this pattern for an elbow, which is used throughout sheet metal working for laying out many patterns of a similar nature in round work for turns

The first step in developing such patterns is always to draw the front view *A*, of the elbow to exactly the dimensions you need. Second, draw the bottom view *B* and divide it into 16 equal points. Number these points starting No. 1 on the seam of the pipe. Third, step off the base line *C-D* equal in length to sixteen of the spaces marked off on the bottom view and number the points as in the drawing. This will give the length of the piece of tin required to make the pipe. The reason for numbering two points one is that when the piece of tin is rolled up these points come together at the seam, making only one point. Project lines upward from these points on the base line as shown by the dotted lines in the drawing. Fourth, from the points on the bottom view *B* project lines upward until they intersect the joint line (see dotted lines in the drawing). Fifth from the point where line No. 9 of the bottom view intersects the joint line *E-F* project a line at right angles until it crosses line No. 9 coming up from the base line *C-D*, make a cross where these number nine lines cross, as in the drawing. Do the same for line 10 and 8, 11 and 7 and so on around the bottom view. Sixth, you will now have a

series of crosses outlining the pattern for *A*. Connect these crosses into a freehand curve. Make the 3/16-in. allowance on each edge for lock seam and you have the complete pattern for *A*.

Now comes the interesting part of this problem. The curve *G-H* is the pattern for every joint shown on the drawing; this is so because every one of these joints are the same angle. To get the pattern for *I* take the distance *F-J* on the front view and set it off as *F-J* on the pattern. In the same way take the distance *E-K* on the front view and set it off as *G-K* and *H-K* on the pattern. Then lay out the curve *G-H* as *K-K*, and the pattern for *I* will be as shown in the drawing.

For the pipe *L* on the front view, with the seam on top, we would use the pattern *G-H-N-M*. For the pipe *O* in the upper drawing, that part of the pattern for *I* marked *K-J-F-G* would give us one-half of the pattern for pipe *O*. For the pipes marked *P* we can use the same pattern curve but the top curve *K-K* would have to be drawn so that the low part *J* of the top curve would be opposite the low part *G* of the bottom curve. Similar adaptations would be necessary for the other pipes.

Making Soldiers in Black and White on the Typewriter

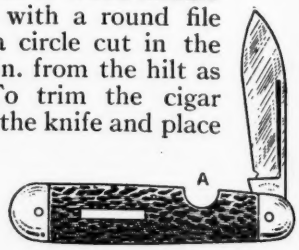
BY the use of a little ingenuity a stenographer, or any person who can operate a typewriter, may hammer out a whole regiment of soldiers on the typewriter, using the letters and punctuation marks found on all the standard machines.

Soldier shaped from type prints

The accompanying sketch shows how lifelike the typewriter drawing is. The "&" sign supplies the head, chest, and arms, a small "o" the body, a period the cap, a capital "W" the legs, a double quotation mark (") the feet, and the hyphen standing space. A colon provides two buttons for the coat, and the transverse line used in making fractions makes a remarkably lifelike gun. Best results are secured by making a whole row at a time. If the typewriter is equipped with a double color ribbon, very pleasing effects can be produced by printing the characters in different colors; for instance, the cap and trousers red and the others black.

A Cigar Cutter Attachment for a Pocket-Knife

TO make a handy and novel cigar cutter procure a bone or wood handle pocket-knife and with a round file make an arc of a circle cut in the handle about ¾ in. from the hilt as shown at *A*. To trim the cigar open the blade of the knife and place the end of the cigar in the arc, shut the blade quickly, and the deed is done. The notch does not harm the knife in any way.—C. T. WANDRES.



The cigar end is put in the notch for cutting

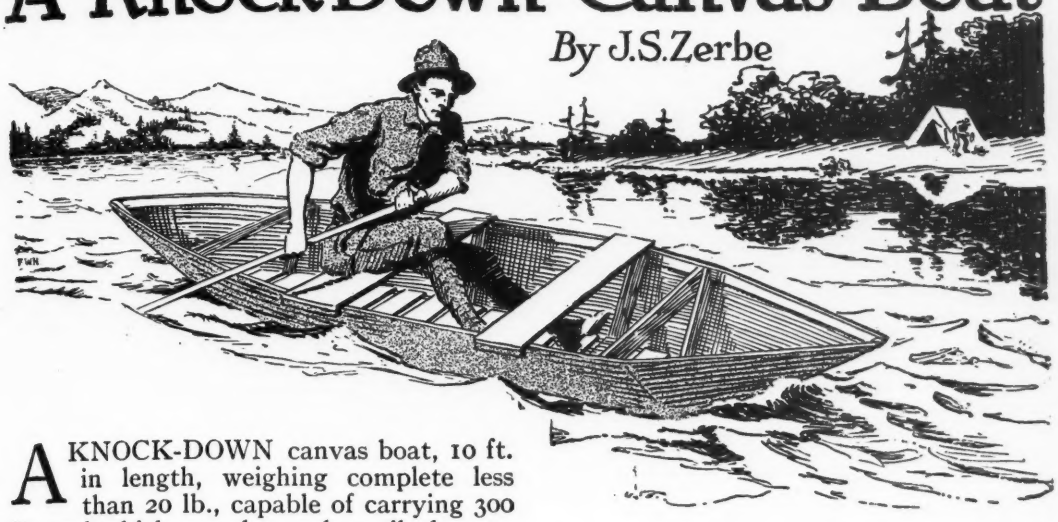
Clothes-Hangers Used for Handles on Barrel Covers

BARRELS used as containers for storing apples, potatoes, and the like are usually kept closed with a detachable cover. To handle such covers conveniently it is necessary to have some kind of a hand grasp. A clothes-hanger will answer the purpose nicely. The kind illustrated has two hooks with a screw point in the center. It is quickly applied.—H. DROBE.

The small double hook screw hanger makes an excellent handle for a barrel cover

A Knock-Down Canvas Boat

By J.S.Zerbe



A KNOCK-DOWN canvas boat, 10 ft. in length, weighing complete less than 20 lb., capable of carrying 300 lb. and which may be made easily by any young man, is illustrated in the accompanying drawings. The entire frame is made of either spruce or birch, the latter preferred, the material being in strips ¾ in. thick and 1½ in. wide. The widest pieces are the seats and keel boards, all of which are 5 in. with a thickness of ¾ in.

The illustration does not show the canvas, as the manner of constructing the frame is the important thing to be considered. When made according to directions it will be found very rigid, even before the canvas is applied. The bulging shape of the keel and the midship section of the canoe have a wonderful stabilizing action on the craft when it is in motion.

Two pieces of keel strips *A* are provided, each 6 ft. long from the center of one hole to the center of the other. To each end of the two parallel keel strips thus described is attached a keel extension strip *B*, each of which is 26 in. from hole to hole. Each hole in these strips is to be bored with a ⅜-in. bit, and bolts 2½ in. long should be used. Suitable washers should be used behind each bolt-head or nut and properly sunk into the surface of the wood so the head and nut will fit evenly.

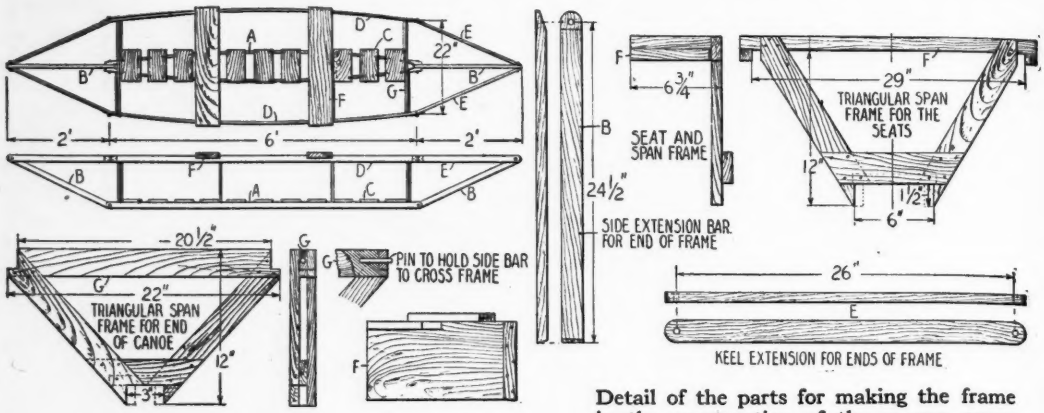
Eleven keel boards, each 6½ in. long, are ranged along the two parallel keel strips, the keel strips being spread apart in the middle so they measure 6 in. from outside to outside. The keel boards *C* are then laid on evenly and nailed to the keel strips, thereby providing a suitable runway for the occupants of the canoe.

The side, or gunwale strips *D*, are 6 ft. long, each end being cut off square on a vertical line, but on an angled line in a horizontal direction. To each end is fitted a side extension bar *E*, by means of a hinge, the opposite end having a hole 24½ in. from the angled end. These extension bars are joined at their ends to the end of the keel extension. The three lapped ends are secured by a bolt.

It is now necessary to join the keel portion with the gunwale frame. A span frame for each end of the canoe, and a pair of span frames provided with seats are placed midway between the end spans. The frame for the ends is made of a top cross-piece *G*, of material ¾ in. thick and 2 in. wide, which indicates the dimensions of all the parts of the span frames. Each cross-piece of the two end frames is 22 in. long, each end having a cut-out portion 1½ by ¾ in. in which the side pieces *D* rest. A hole through the side piece and end of each cross-piece permits a pin to be driven in to hold the parts together until the canvas is applied. The fabric will prevent the pin from coming out.

Two V-shaped pieces extend down from the ends of the cross-piece, the lower ends being held together by a short cross-piece. The ends of the V-pieces are cut so they span the keel strips, while the short cross-piece rests on the keel strips and thus serves as a support for the upper framework. The seats *F* are each 30½ in. long, and at each end is a cross-strip or cleat,

¾ by ¾ in. in size, nailed thereto. The two lower depending strips, arranged in V-shape, are secured together at their lower ends by a cross-strip which rests on the keel strips, in the manner described in



Detail of the parts for making the frame in the construction of the canvas canoe

reference to the end frames. Pins or screws may be used to hold the seat frames to the body of the canoe, but small bolts are preferable for this purpose.

The entire framework, together with the canvas and oars, can be knocked down and folded in a space 6 ft. long, 1 ft. wide and 6 in. thick, and can easily be shouldered and carried by a boy. The end extension pieces *B*, swing down and rest between the keel strips *A*. The hinges on the side bars *D*, provide a means for swinging the end pieces alongside the bars for packing purposes.

The Cause and Prevention of Rim Cuts on Tires

PROTECTION from rim cutting is not afforded by any particular type of tire but depends rather upon the design, quality and usage. No good tire of standard type will be cut by any standard rim, if properly used. On the other hand, any type of tire will be injured if subjected to abuse. Under-inflation, dented and irregular rims, excessive loads, tire fillers and stiff reliners are the common causes for cutting and breaking above beads. The flanges of a rim may be battered down and roughened as a result of a tire being used deflated for a considerable distance. When another tire is applied it is sure to cut above the beads.

Tires carrying heavier loads than those for which they are designed may break at the beads where they are engaged by the clinchers of the rim. If rims become rusted from water working in around the beads when the tires are run soft, or through neglected cuts in the tires, or from neglect to put proper fittings on the valve stem, the rust should be removed with emery paper and the rims painted with a coat of aluminum, graphite and oil.

It is not uncommon for tires to be applied to rims of wrong size through a mistake as to dimensions. Sometimes a 36 by 4½-in. tire is placed on a 36 by 4-in. rim. The diameter of this rim is approximately 28 in. and the diameter of the beads of the tire approximately 27 in. for a quick detachable type, and approximately 26 in. for the regular clincher type, therefore it becomes necessary to stretch and strain the beads considerably. Again, the 4½-in. beads are not constructed to fit a 4-in. rim, and will not engage properly in the clinchers. Good results cannot be secured when the beads are strained and crowded in this manner.

Trick of Passing Cigarette Smoke Under Handkerchief

PLACE an ordinary china saucer over an empty glass tumbler and cover the whole affair with a handkerchief. Place the bundle on a table. Light a cigarette and blow a few rings of smoke towards the hidden tumbler. Then make a few magical passes. Remove the handkerchief and saucer and the smoke will be found in the glass.

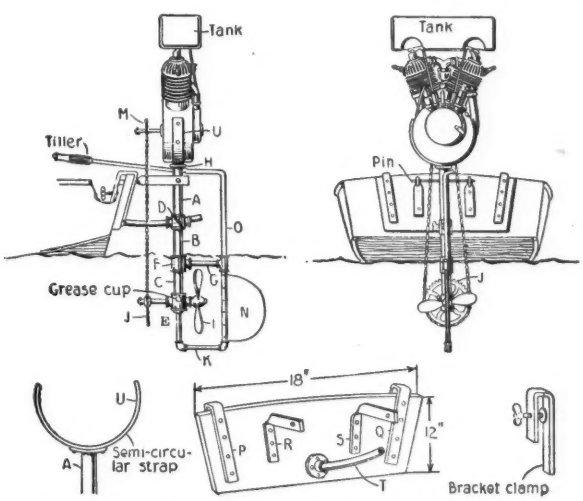
To effect this you rub a few drops of hydrochloric acid on the inside of the glass and some ammonia on the saucer. The two fumes combined produce a vapor resembling cigarette smoke.

An Outboard Motor Made of Pipe and Fittings

A SERVICEABLE and satisfactory outboard motor for a rowboat can be constructed from a second-hand motor-cycle engine and ordinary pipe and fittings. Either the one-cylinder or a "twin" motor can be used, the only difference being in the mounting, which can be worked out by an amateur mechanic.

While the stern transoms of rowboats vary somewhat in size, the dimensions herein given will suffice for the average boat. Any increase or decrease in the length of the upright supporting the motor can be adjusted by varying the length of one of its sectional parts, as shown in the drawing.

There are two essential parts to its construction; the motor and propeller frame and the supporting board. Sections *A*, *B*, and *C* are made of 1¼-in. pipe. The parts *D* and *E* are the same size cross tees while *F* is a 1¼-in. coupling with a ½-in. threaded opening in the side at *G*. The total distance from the flange *H* to the bottom of *E* should be sufficient to immerse the propeller-blade at least 3 in. under water, and the distance from *G* to the center of *E* must be at least 6 inches.



The parts in detail for making and attaching a motorcycle engine to a rowboat for an outboard motor

The propeller *I* should be not over 10 in. in diameter and of shallow pitch, to allow for the usual high speed of motorcycle engines. This is connected with a tool steel shaft revolving in the proper bushings in *E*. The other end of the shaft carries a large sprocket wheel *J*.

The rudder hanger *K* is made of ½-in piping by means of two straight pieces and an elbow. Fit the lower end with a tee to receive the bottom rudder-peg. A corresponding piece of ½-in. pipe is threaded into *G*.

Thread a small hole in one side of *E* and fit with a thumbscrew, then bore a ½-in. hole about 2 in. under the flange on *A* and through the side of the pipe.

The mounting of the motor must necessarily be left to the builder, as each of the varied types and makes of motors must be mounted in its own way. The semi-circular strap shown in the drawing can, however, be adapted to several different standard makes. In any case be sure that the small sprocket *M* is lined up with *J* and that the crankshaft is long enough and pinned, to accommodate a starting handle.

The rudder *N* can be cut out of heavy galvanized sheet iron and riveted to the rudder rod *O*. This rod extends up as far as the base of the motor and is connected with the tiller by an elbow. The tiller is swung off at an angle so that it turns either way to clear the motor and frame.

Connect the two sprockets with a light motorcycle chain and cover well with heavy grease.

The supporting board can be made of a piece of heavy oak 18 in. long and 12 in. wide. Curve the top edge to conform with the curve on the edge transom.

Have a blacksmith make two heavy iron brackets *P* and *Q* and fit the short ends with thumbscrews as shown. Bolt one bracket to each end of the board, countersinking the bolt-heads on the underside. The smaller brackets, *R* and *S* should be sufficiently heavy to hold the motor and frame by means of a steel pin passing through the holes in the ends of the brackets and the hole in the pipe *A*.

Bend a short piece of 1-in. pipe so that the curve will equal the arc made by swinging the suspended motor frame back and forth on the pin. Then secure the pipe to the board by means of a wide flange so it will travel through *E*. The motor can be held at any point along *T* by the thumbscrew, according to the pitch of the transom.—L. B. ROBBINS.

Making and Using a Casting Rod

I.—The kind of material, size and fittings for a casting rod

By Stillman Taylor

A ROUGH-AND-READY fishing pole may be quickly fashioned from almost any pliable wood, but the construction of a nicely balanced and flexible casting rod requires careful workmanship. No special skill is required, and as only a few common tools are needed, any boy of average ingenuity will be able to make a first class one that even an expert can use with satisfaction and which will compare favorably with the better class rods sold in the stores. A rod of this kind is somewhat expensive to buy, but as labor and retail profit represent almost two-thirds of its actual cost, a really fine rod may be built by the amateur at a comparatively small cost.

Tools and Materials

The tools required are: a 4 or 5-in. block plane, a 14-in. single-cut mill file, a thin fine-tooth saw, a steel cabinet scraper, a small oilstone to keep the plane iron sharp and a few sheets of No. 1 and 0 sandpaper.

To obtain the proper taper to the rod, a calipering tool of some kind is essential, for this work cannot be done by eye or by measuring with an ordinary rule.

As the hand-made split bamboo rod possesses the greatest strength and elasticity with the least weight, it is regarded as the standard. But this material is so difficult to work, that only the more expert amateurs can succeed in making a first class rod of split bamboo. Different woods are used in rod making, but expert anglers prefer Bethabara, Greenheart, Dagama and Lancewood. Bethabara makes a fine rod, but it is hard to work; Greenheart is a fine material, but good quality stock is difficult to secure; Dagama possesses the strength and elasticity of the above, has a straighter grain, is free from knots, and does not warp readily, hence is the best for the amateur. Dagama stock in the square is easy to obtain at moderate cost. Lancewood is softer, full of small knots, and costs about the same as Dagama.

Specifications for a Casting Rod

Length 5 ft., weight about 6½ oz. Handgrasp—cork. Rod tapered as follows: Butt Joint 24 in. long, tapering from 15/32-in. to 19/64 inch at ferrule; Tips 3 ft. long, tapering from 17/64 inch at ferrule to 7/64 in. at tip; sections can be made same length if desired but the longer tip type is much better in action and makes a stronger rod for the same weight. Material—Dagama in square. Butt 2 ft. long by ⅝ in. square. Tips 3 ft. long by ⅜ in. square.

Mountings

1 Shouldered and belted ferrule, 17/64 in. with closed end center for each tip.
1 Reel-seat, with straight hood, ¾-inch.
1 Butt cap, 1-in.
1 Taper, small end 15/32-in.
2 Offset angle casting tops, 3/32-in. (1 for each tip.)
4 Narrow casting guides, ½ in. (2 for each tip.)
3 Doz. cork washers, 1⅛ in. diameter, ¼-in. thick.

Before commencing work, draw a diagram giving the actual taper the full length of the rod, as shown in Fig. 1, with the cross stations spaced at 6-in. In a piece of sheet zinc or brass, cut or file a series of slots in one edge to correspond to the diameters on the diagram, making the slots perfectly square, as in Fig. 2. With this gage check up the work.

Before making an attempt to plane the stick, run the plane along it to find out which way the grain runs. Select one end for the butt of the rod, and drill a couple of small holes, about ¼-in. from the ends, making the second hole at right angles to the first, as shown in Fig. 3. Drive a brad or small finishing nail in one end of the bench, and hook the stick over the head. This holds the stick firmly so that it will not slip about during the planing.

Plane the stick on four sides, from end to end, until it is ½-in. square. Set the plane very fine, with the breaker-iron close to the edge of the plane-iron, and ground as sharp as possible. Draw cross lines on the

ends to find the center, and mark off the length of the hand-grasp. While a shorter grasp is sometimes preferred and used on tournament rods, the best length is a double-grasp measuring 12 in. overall, including the taper and butt cap. Plane the stick with the grain until it is evenly tapered in the square, planing from butt to joint, and check often with gage until the exact dimensions are obtained.

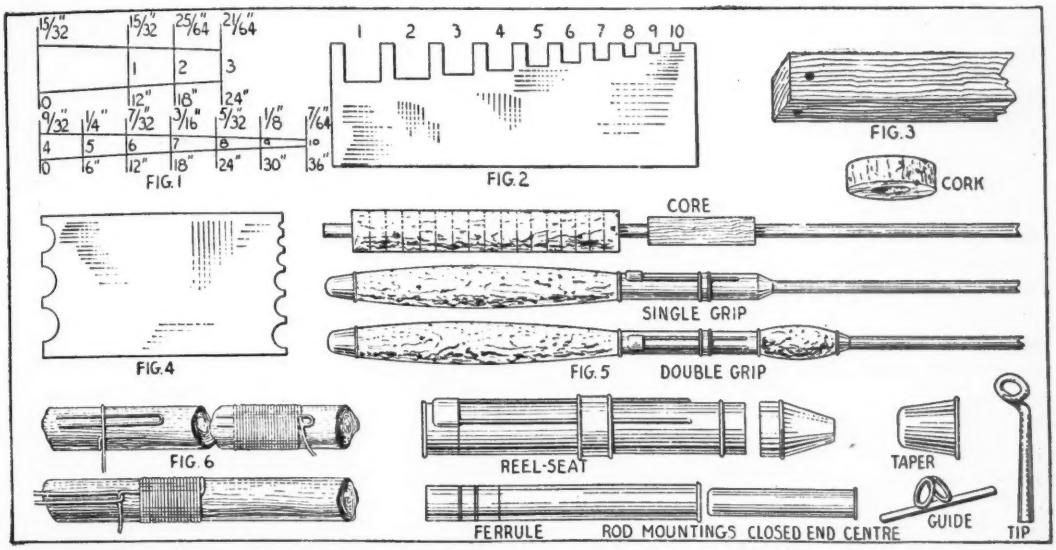
The work of rounding up the stick is accomplished by using a length of common ⅞-in. flooring with a groove in one edge. Plane the groove to roughly correspond with the taper of the rod. Nail or clamp the board with groove uppermost on the bench, and lay the stick in the groove. Plane off the four corners to make the stick octagon in form, then take off these corners to make it sixteen-sided. Work very carefully, setting the plane very close and use the gage often to obtain the desired taper.

The stick will now be almost round, and for the final rounding, make a scraper by filing grooves of different sizes in one edge of the steel cabinet scraper, shown in Fig. 4. As the bottom of the groove does the scraping, make it sharp by using a fine-cut file and hold it at right angles to the steel. With this little tool the edges are reduced to shape and sandpapering will make the rod smooth and free from hollow places.

The hand-grasp is fashioned from solid cork-washers. These corks may be purchased punched to any desired diameter, but it is a simple thing to punch them by taking a common brass ferrule 15/32-in. in diameter, sharpening the edge with a file. Fold several thicknesses of cloth over the end to make a pad for the hand, and rotate the cutter, back and forth, pressing down at the same time, to force the cutter through the cork. Do not hammer the cutter, for this will make a ragged hole. Corks of 1⅛-in. diameter and ¼-in. thick are best, but the ½- or ⅝-in. thick corks obtainable from any druggist may be used.

Cut the butt off square above the holes, brush on a ½-in. band of liquid glue, and force the cork down in place. Coat the upper face of this cork and another section of the butt with glue, and force the second cork down against the first. Proceed in this manner until the grasp is of the desired length, 4¾ in. being about right for the lower grasp.

The reel-seat is now fitted over a soft wooden core. This core may be purchased for a few cents, bored to any desired diameter, or made from white-pine. Bore a 15/32-in. hole in a stick of pine, and plane down to fit. The butt end of the core should be cut off ¼ in. shorter than the reel-seat, at each end. As the ordinary reel-seat is rather long, cut it down to 4-in., reverse the hood and place it at the bottom end of the seat nearest the hand. When the core is a snug fit, give the upper surface of the cork and the butt it covers a



Plan for the taper, gage and way of holding the rough wood for planing it to shape, together with the manner of cutting the handles from ordinary corks and the fittings for the entire rod

coat of glue, and push the core down into place. Coat the core with glue and push the reel-seat down over it, forcing the metal edge well into the cork to make a waterproof joint.

The upper grasp is now formed on the butt above the reel-seat in the same manner as the lower grasp. Make this 2½ in. long. When all corks are glued in place, lay the rod aside for 24 hours to harden, before attempting to shape it.

The cork may be turned in a lathe, or roughly shaped with a sharp knife—a sloyd knife is a handy tool for this work—and sandpapered to make it smooth. A swelled or oval grasp is the best, and the writer prefers to form a ring ¼-in. from the reel-seat to make a rest for the forefinger when casting, thus doing away with the metal finger hook. This and many other points may be seen by referring to the cut shown in Fig. 5.

To prevent the reel-seat and butt-cap from turning, a small hole is drilled in the hooded end of the reel-seat, and on the edge of the butt-cap, and a small brass pin is driven in. To avoid weakening the wood, drive the pin in a little way, and file off flush.

The tip is planed and rounded in exactly the same manner as the butt-joint. The metal taper which finishes off the upper hand grasp, the ferrule, closed-end centers and casting tops, are first carefully fitted by filing down the wood. Use ferrule cement to hold it in place, first melting the cement and then smearing a little on the wood and in the tube.

The final varnishing is done after the guides and whippings are in place, but a thin coat of varnish should be brushed on and allowed to become thoroughly dry before the rod is whipped. This makes the wood waterproof beneath the whippings. Any good outside spar varnish may be used, or extra light coach varnish.

Two guides are needed on a rod up to 6 ft. in length, the first being affixed to the tip 7 in. from the closed-end center, and the second 15 in. from the first. No guide is required on the short butt-joint of a casting rod, as the line renders more smoothly without it.

Smooth off the rough spots of the bases of the guides with a fine file, and affix roughly in place by a few turns of common thread around one half of the base. Common sewing silk in size "A" may be used, but oo size is better for small rods. This size can only be obtained from a dealer in rod-making or fly-tying supplies. Red and green or red and yellow are the favored color combinations.

Guides and whippings are put on with the invisible knot, shown in Fig. 6. A good way to wind the rod is to hold the spool of silk in one hand and rotate the rod with the other, letting the strands of silk coil closely against each other. A loop of waxed silk is inserted as shown, and through it the end of the whipping is carried beneath its coils to make a strong and invisible finish. Whippings may be wound on at any desired distance, but many narrow turns will make a neater appearance than wide bands of color. Red and green, red and black, with an occasional edging of yellow, always prove satisfactory.

When all windings are on, coat with orange shellac dissolved in alcohol to make a medium thick varnish. Do not shellac the rod, and let the silk dry well before varnishing the rod.

A camel's hair brush about ½-in. wide answers for this work. If varnishing is done outside, select a warm, sunny day, otherwise do the work in a warm room, free from dust. Warm the varnish by putting the can in a dish of hot water before using. It will now spread smoothly, and every bit of the wood should be touched. Hang up to dry by the tip, and allow at least three days before brushing on the second and final coat. If the rod is much used, it is a good plan to brush on a third coat later on in the season.

An Emergency Burning Glass Made of Match Crystals

SOMETIMES the need for a burning glass arises where one is not obtainable—for instance, in the woods to light a fire without matches. Two watch crystals, fitted together and filled with clear warm water, will prove very effective. Smear the edges with thick mud to keep the water from running out.—E. D. RIES.

The Trick of Burning a Lump of Sugar

APPLY a match to an ordinary lump of sugar such as you find in little cubes for table use, and it will not burn. But, strange to say, if you cover the cube of sugar with cigar ashes and then apply a lighted match it will begin to burn.

Military Marching for Beginners

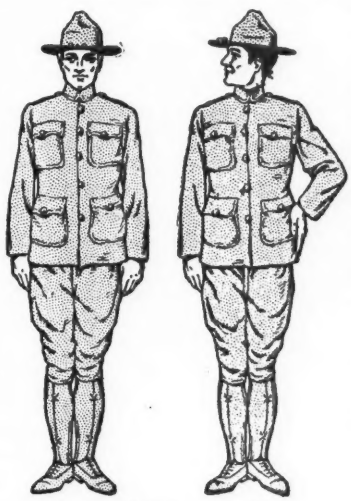
The fundamentals of military marching illustrated to show the correct positions of a soldier in line

By Albert B. Wegner

IN these stirring times it is important that boys of all ages and men of military age should at least know some of the fundamentals of military tactics. There is nothing more fundamental than marching. Every group of boys or men who wish to march should send for the U. S. Infantry Regulations, price 35c, to the Superintendent of Documents, Government Printing Office, Washington, D. C. Unfortunately, this excellent guide is not illustrated and its detailed descriptions are hard for the novice to understand. Then, too, although the matter is arranged logically it is not in the best order for teaching a beginner. The writer attempts here to describe and illustrate these fundamentals in the simplest and most progressive manner.

Forming a Line

The first thing to do with a group of marchers is to get them formed in a line. The instructor, or officer, calls out, "Fall in." At this, the men line-up in two lines, called "ranks," one rank 40 in. back of the other and with the tallest at the right of the lines. (The tallest man in the front line; the next is directly back of him; the third tallest takes his place at the left of the tallest in the front rank; number four is back of number three, etc.)



The positions of "Attention" and "Eyes Right" in forming a Company line

Those at the extreme right of the lines are the "guides." At the instructor's call "Fall in" the guides take their places facing the instructor. They stand erect, with left hand on the hip, fingers pointed downward, eyes straight to the front.

The next in line take their places at the left of the guides so that their right arms just touch the left elbows of the guides. With left hand on hip and heads turned to right (called "eyes right") they aline with the guides.

All of the others "fall in" in the same manner. As soon as each one feels the one at his left touch his elbow he himself drops his elbow and turns his head to the front.

The position that each now has is called "Attention" in which he stands erect, heels together, shoulders back and down, feet at 45 deg. angle.

The instructor now calls, "Right dress." At this all place the left hand on the hip and turn eyes to right, holding that position until the instructor goes to the right of the lines to see if they are straight. If anyone is out of alinement he calls to him "Mr. —— forward" or "backward" as the case may require. If several are out of alinement the instructor calls attention to that part of the line as "backward at the center," or "forward at the left." After the instructor is satisfied that the lines are straight he commands "Front," at which all face to front, dropping their hands into position of "Attention."

Simple Movements While Standing in Line

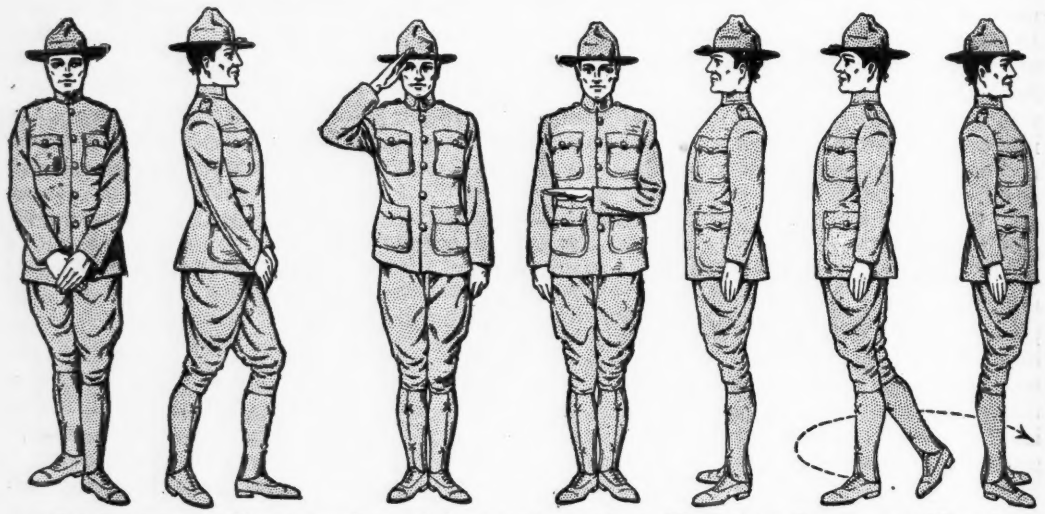
The next things to learn are a few simple movements while in line. Nearly all commands are given in two parts. The first is the "preparatory command," that tells the soldier what to do. The second is the "command of execution," when he must begin the movement. There is always a pronounced pause between these commands so as to give all time to understand and prepare for the movement.

"Parade—Rest." At the command "Rest" step backward 6 in. with the right foot, the body weight on the right leg, the left knee slightly bent. At the same time place the thumb of the left hand between the thumb and forefinger of the right hand, all fingers extended downward.

"Company—Attention." At the com-

mand "attention" take the position already described for attention. "Rest." At this command the soldier may speak or do anything he likes as long as he keeps one foot on the line. "At Ease." This is like "Rest" except that there must be no talking. "Fall out." At this all may get out of line and do as they please; but they must remain near-by.

After any of the above commands the instructor must always bring the company to "attention" before giving them any other command. After the command "fall out" he must give them "fall in" to get them at "attention."



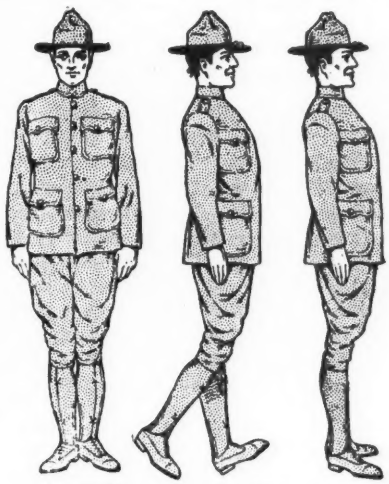
The first command is preparation and the second execution. The first two figures are at "Parade Rest," the third, "Hand—Salute," the fourth, "Rifle—Salute" and the last three are of the "Right Face" and "Left Face," each one making a quarter turn to right or left in two counts

"Hand—Salute." Raise the right hand smartly to the hat brim above the right eye with the forearm at an angle of 45 deg. then lower it smartly. "Rifle—Salute." This command is given only when soldiers have rifles. The left forearm is raised horizontally across the body, the palm of the hand downward. "Right—Face." Each one executes a quarter turn to right in two counts. On count 1 turn to right on the right heel and the left toes. On count 2 bring the left foot to "attention" (see picture). "Left—Face" is done conversely. "About—Face." This is a half turn and is always done to the right. After the command "Face" is given, place the right foot about 6 in. back of the left with toe of the right shoe on the ground. Now turn on the left heel and right toe half way about. This will bring the heels together at "attention." "Mark time—March." This is stationary stepping (no advance is made) and is done by lifting the feet only about 2 in. at each step. If the command is given while standing still, start stepping with the left foot. "Forward—March." Step forward with the left foot first, 30 in. at each step, arms swinging naturally. "Company—Halt." At the command "Halt," given as either foot strikes the ground, step forward with the other foot and then bring the rear foot up to "attention." "Half step—March." Take steps of only 15 in. each. "Backward—March." March backward, start with the left foot, 15 in. at each step. When "Company—Halt" is given while marching backward execute it conversely to the marching forward. "Right step—March." Step sideward to right, right foot first, keeping the body to the front. ("Left step" conversely). "Double time—March." This is the command to run. "Quick time—March." At this command resume the ordinary marching time.

The command "Halt" or "Mark time" must be given if it is desired to change from marching forward to either backward or side step or the reverse. To keep the company marching in step the instructor counts almost continuously, "One, two, three, four," and when he sees anyone out of step he calls to him, "Get step." Each one is responsible for keeping in line. For this he must constantly give attention to those at his right. If the officer sees any who are out of alinement he calls to them,

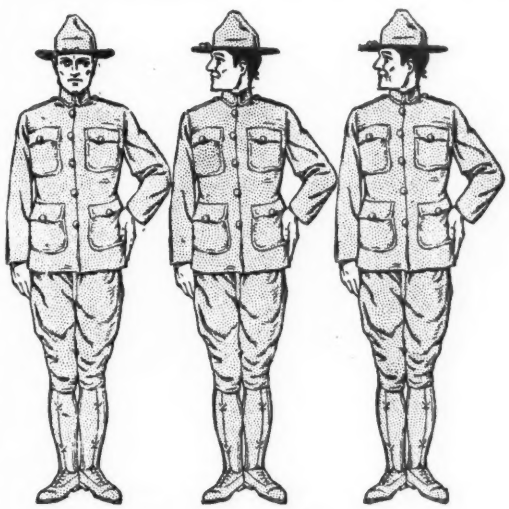
"Guide right," or "left" as he desires.

"Change step—March." This means a quick change of step by bringing the right foot up to the left and then stepping forward again with the left (or conversely). It is similar to the movement known among children as "skipping," but, of course, done only once and not continuously as in skipping. "Route step—March." In this the soldiers keep in line but need not keep in step. Talking is allowed. "At ease—March." This is like "route step" except that talking is not allowed.



"Left Face" is a half turn on the left heel and right toe

"By the right flank—March." At this command *each one* turns to the right and marches at right angles to the previous direction. The command "March" must be given as the right foot strikes the ground. Each one then steps forward and turns on the ball of the left foot, then steps in the new direction with the right foot (see diagram). The converse when done to left. "To the rear—March." The command "March" must be given as the right foot strikes the ground. Each one then steps forward with the left foot; then turns to right on the balls of both feet; then steps forward in the opposite direction with the left foot. (This is never done to left.) "Right oblique—March." Each one makes an eighth turn to right and marches in an oblique direction, starting with the left foot. If the command "Halt" is given while marching obliquely each one halts and then turns in the former marching direction. If the command "Forward—March" is given while marching obliquely, all turn and march in the former direction.



This position is "Right Dress" with face to the right and the elbows touching the next person in line so he can feel it

Company Movements

These maneuvers may be done with few or many men in line, but the following ones must have at least two squads (16 men) and it would be better to have four squads. After the company executes "Fall-in," "Right dress," and "Front" the instructor commands "Count off." At this, beginning with the tallest men at the right of both lines they count in rotation "One, two, three, four." The first four front line men together with their rear line men constitute the first "squad" (8 men to a squad); the second eight are the second squad, etc.

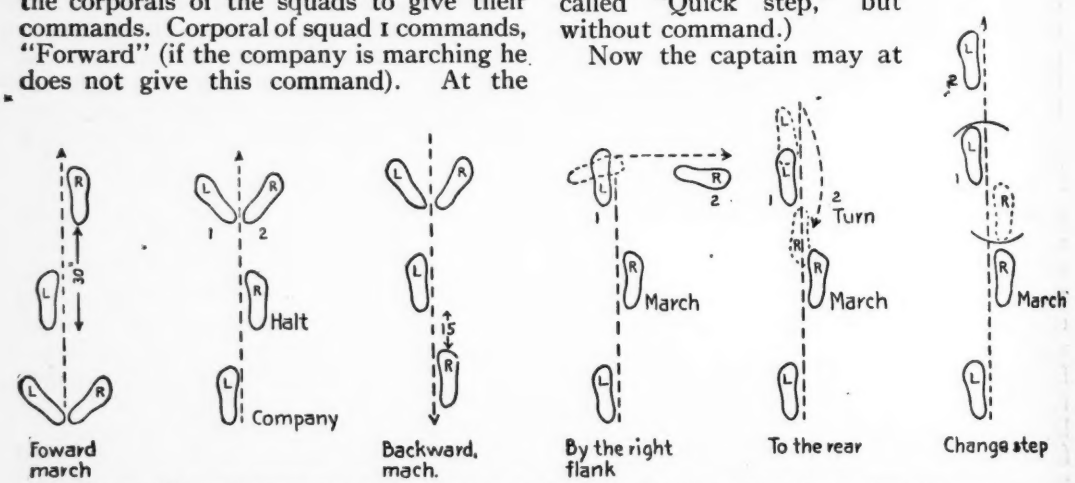
"Squads right—March." At this command No. 1 of the front rank of each squad executes "Right face" and then "Mark time." The others of the front rank execute "Left oblique" and place themselves beside No. 1 on the new alinement. No. 4 of the rear rank steps directly forward 4 steps, No. 3 three steps, while No. 2 and 1 follow No. 3. This brings them back of their corresponding front line men upon whom they close to marching distance; then all eight without further command march forward in the new direction. (Conversely to left.) "Right by squads—March." This command sounds much like the preceding one but is executed differently, although it too is used to bring the company from a line to a "Column of squads" (squads back of one another). At the command "March" squad 1 marches directly forward. The other squads execute "Squads right" (described above) and then "Column left"

(described below) so as to follow after squad 1. (Conversely to left.) "Column right—March." This is a "follow-your-leader" movement and may be done when the company is marching in column of squads, single file or by twos. When marching in columns of squads, squad 1 executes "Squads right"; then as each of the other squads come to the place where squad 1 turned they also take the command, "Squads right," so as to follow squad 1. (Conversely to left.) "Squads right about —March." In this each squad executes two "Squads right" in succession so that they now march in the opposite direction. (Conversely on the command "Squads left about.")

There are three ways of getting a column of squads into a line again. The simplest is to have them do "Squads left—March" (or "Squads right"). In the other two ways the line must come to a halt. "Left front into line—March." The captain of the company commands, "Left front into line," then waits a moment for the corporals of the squads to give their commands. Corporal of squad 1 commands, "Forward" (if the company is marching he does not give this command). At the same time the corporals of the other squads command, "Left oblique." Then the captain commands, "March," upon which each squad executes the command of its corporal. The captain may then at any time command, "Company—Halt," upon which squad 1 only halts and its corporal commands, "Right dress." When the other squads have marched a squad's length left obliquely their corporal commands, "Right oblique—March." When they have come up to the left of squad 1 their corporal commands, "Squad—Halt," and then, "Right dress." After the squads have all thus halted and dressed at the officer's order, the captain then commands "Front." ("Right front into line" is done conversely, of course.)

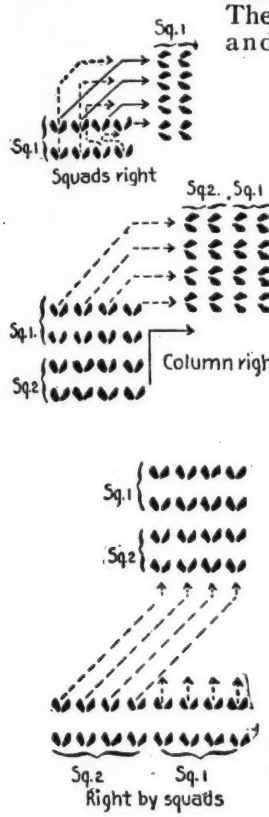
"On left into line—March." The captain of the company commands "On left into line," and then waits until the corporals of the squads have given their commands. Corporal of squad 1 commands, "Right turn." At the same time the other corporals command, "Forward." Then the captain commands "March," upon which each squad executes the command of its corporal. ("Right turn" is executed as follows: No. 1 squad faces to right and takes "Half step." The rest of the front rank "Right oblique" without command and place themselves again to the left of No. 1. The rear rank do the same movement when they come to where squad 1 turned. Then when the rear rank has arrived at their proper distance back of the front rank the entire squad takes up the regular step of 30 inches, called "Quick step," but without command.)

Now the captain may at any time command, "Company—Halt," upon which squad 1 only halts and their corporal commands, "Right dress." Each of the other squads marches forward until it gets a squad's length beyond where its predecessor turned. Then the corporal commands, "Right turn—March." When they come into line he commands, "Squad—Halt," and then, "Right dress." Then when all squads are in line and "dressed" the captain commands, "Front." "On right into line—March." Squad 1 executes "Squads right." Squad 2 marches forward to a point one



"Forward March" starts with the left foot, and "Company Halt" as either foot strikes the ground; "Backward March" with the left foot; then "Right Step March," "To the Rear" and "Change Step"

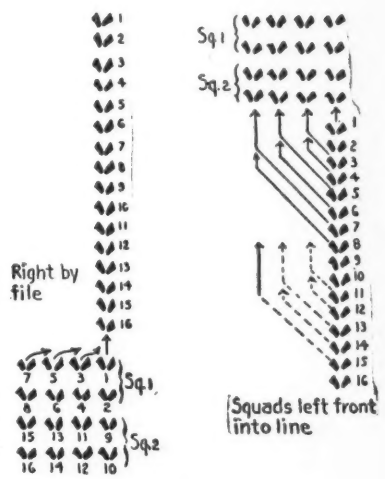
squad's distance beyond the point where squad 1 turned, then it does "Squads right." Each of the other squads thus goes beyond where its predecessor turned and then they also turn. At "Company—Halt" squad 1 halts. The other squads halt and "right dress" when they come up to where squad 1 halted.



If while the company is marching in columns of squads it is desired to get them into single file the command is, "Right by file—March." At this Nos. 1 of squad 1 march directly forward. All the others halt. Nos. 2 of both ranks follow Nos. 1 of both ranks, etc. To form them into columns of squads again the command is "Squads left front into line—March." Nos. 1 of each squad halts. The others "Left oblique" and take their places in the squad. "Right by twos—March" is the same type of formation as the above but marching in twos. To get them into file of squads the command is the same as above.

Of course all of these may be done conversely in the other direction. Marching in file and by twos is seldom used in the army because it takes too much time and room to be very useful, but in small groups it is a good variation.

"Company—Right." This maneuver is executed while in line formation and means a quarter right wheel or swing of the entire company. No. 1 of squad 1 makes a "Right face" and marks time. All of the others "Left oblique" until they get in line with him again; then the officer commands



The same orders executed in squads of sixteen men each, showing their positions taken and lines of march

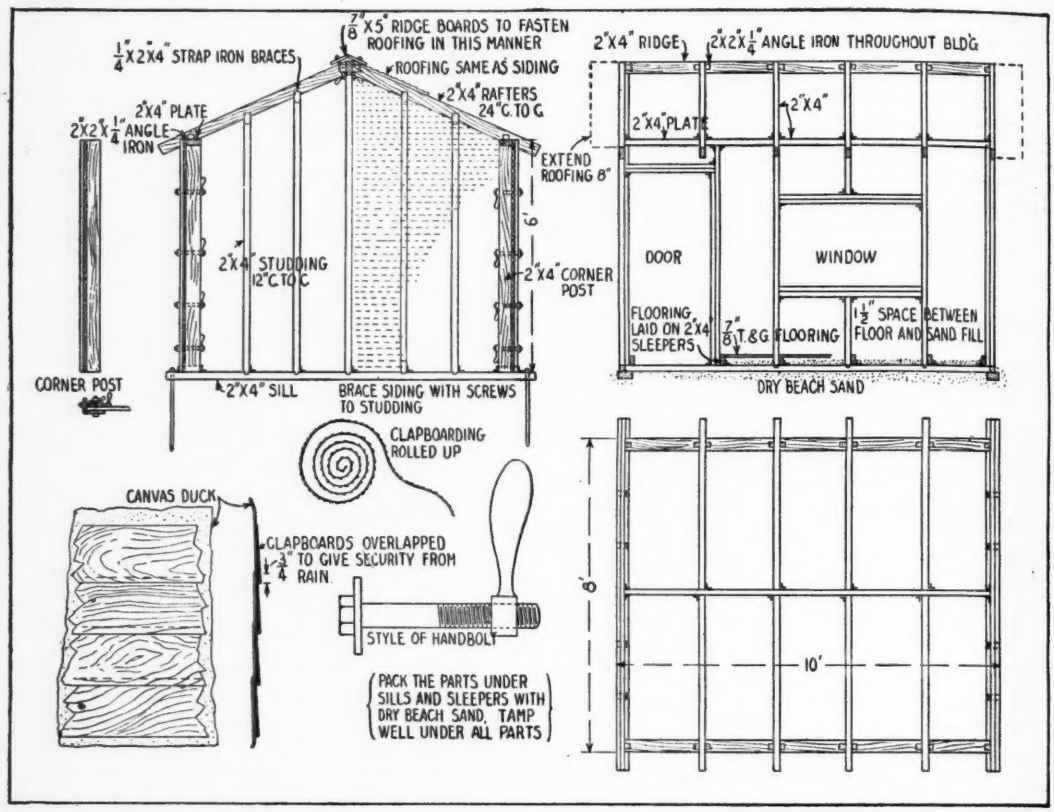
"Forward—March" or "Company—Halt," as he wishes. To dismiss the company the officer brings it to "Attention" then commands "Dismissed."

Burning Out Designs on a Piece of Paper

THIS sort of amusement can create considerable fun. This idea has been used many times in advertisements on post cards in this manner: A given point is lighted with the glowing end of your cigar or match and it causes a trail of fire to slowly eat itself around the paper until it has traced out some name or design. The same thing can be done with a newspaper and any design or wording worked out such as "Merry Xmas," "Welcome," etc. Just outline the wording with a pointed brush dipped into a concentrated solution of potassium nitrate. Allow the paper to dry and all tracings will vanish. Mark the paper with a pencil so that the start of the line can be determined and then light it with a red hot poker, cigarette or something which will not make a flame to burn up the paper, but cause the invisible lines to burn out as the fire traces its arranged course.
—CLARENCE T. HUBBARD.

Knockdown Walls to Make a Portable Summer House

SUCH a popular demand has been created for knock-down building material for furniture, boats and the like, that some manufacturers are now furnishing "ready-made" houses, shipped in pieces, cut to lengths and marked so that a handy man can set one up or build it for a permanent home. The illustrations show such a house. It is not really a "ready-made" given in the plans. The siding and roofing material are also distinctive features of this house. The siding and roofing boards used are the small narrow kind. They are made to lap in the usual manner and are backed with canvas, like parquet flooring or the covering for a roll-top desk. In making the siding or roofing, the boards are attached to the canvas with the best grade of cabinet glue. This form of construction keeps the siding in the exact areas in which they are used on the building


7/8" X 5" RIDGE BOARDS TO FASTEN ROOFING IN THIS MANNER
1/4" X 2" X 4" STRAP IRON BRACES
ROOFING SAME AS SIDING
2" X 4" RAFTERS 24" C. TO C.
2" X 4" PLATE
2" X 2" X 1/4" ANGLE IRON
EXTEND ROOFING 8"
6'
2" X 4" STUDDING 12" C. TO C.
2" X 4" CORNER POST
CORNER POST
2" X 4" SILL
BRACE SIDING WITH SCREWS TO STUDDING
CLAPBOARDING ROLLED UP
CANVAS DUCK
CLAPBOARDS OVERLAPPED 3/4" TO GIVE SECURITY FROM RAIN
STYLE OF HANDBOLT
PACK THE PARTS UNDER SILLS AND SLEEPERS WITH DRY BEACH SAND, TAMP WELL UNDER ALL PARTS
2" X 4" RIDGE
2" X 2" X 1/4" ANGLE IRON THROUGHOUT BLDG.
2" X 4" PLATE
2" X 4"
DOOR
WINDOW
FLOORING LAID ON 2" X 4" SLEEPERS
7/8" T. & G. FLOORING
1 1/2" SPACE BETWEEN FLOOR AND SAND FILL
DRY BEACH SAND
8'
10'

The studding, joist and sills are so constructed that they may be readily taken apart. The siding is put on canvas for rolling it up like a carpet so that the whole house is readily stored

structure, but is designed so that the parts will fit together without any permanent fastenings, so that the owner may move it from place to place as desired. It is especially adapted to the summer camper, or for the person who desires to live by the seashore during the hot months of the year.

One of the features of the building construction is that the angle-irons used are permanently fastened to the wood pieces in such a manner that they aid in distinguishing the parts for their respective places.

The size and dimensions of the parts are and they may be rolled up like carpet and stored for the winter.

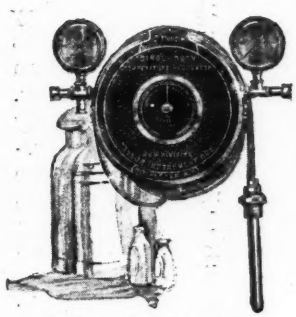
The method of holding the siding is clearly shown in the plans. It consists of applying the sections and clamping their ends at the corners with corner-boards, using bolts with lever-nuts. A few screws are put in here and there to keep the boards from warping. Long dock-bolts, run through each end of the sills and into the ground, keep the building rigid. The door and windows are of light mill stock, secured by hand-bolts to their frames.

TYCOS

What It Means

By Waldemar Kaempffert

BACTERIA are deadlier than bullets. Before Pasteur discovered that, babies died of "summer complaint," "inflammation of the bowels," and other vaguely named, misunderstood ills no longer mentioned in medical lexicons. They died because the cow's milk fed to them was swarming with invisible disease germs. Pasteur showed that heat killed the germs and made the milk safe to drink. That is why milk is "pasteurized," which means that it has been heated up to a certain point.



The lives of countless thousands who drink milk depend on the infallibility of Tycos temperature devices

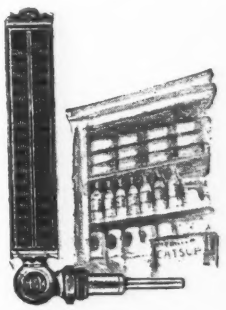
The temperature to which the milk is heated must not only be accurately known but carefully maintained. If it is too low the germs are not killed; if it is too high the milk is cooked, so that it is difficult to digest.

In the modern sanitary dairy thousands of gallons of milk flow through a heater. The temperature rarely varies even a fraction of a degree from the critical 145 degrees. It is automatically controlled by a wonderfully accurate instrument which regulates the amount of steam supplied to the heater. No human hand is so sensitive, no human brain so watchful as that ingenious mechanical intelligence. The lives of thousands who drink that dairy's milk depend on the faultless workmanship, on the infallibility of that device.

On the face of that instrument stands the name "Tycos Temperature Regulator."

One bottle of homemade catsup out of twelve may spoil; a housewife is not a failure because of that. But a vegetable-canning factory might face bankruptcy if even one per cent. of its products were unsalable. Your health and the factory's reputation—that intangible something which you take on faith—are dependent on the maintenance of quality. Why is it one can of tomatoes on a grocer's shelf is as good as every other can of tomatoes? Why is one can of corn like every other can?

Vegetables must be cooked before they are canned. Most of them contain starch. Raw starch is indigestible. So, the canner must cook his corn. Mechanical arms stir the corn in a huge kettle. A metal rod dips into the kettle too. It is like your finger—that rod; it *feels* how hot is the corn. It expands and contracts with the slightest rise or drop in temperature and signals back to a valve on a steam-pipe. "Turn off the steam," it says if the corn is too hot; or "more heat," if the temperature is falling. And the regulator responds instantly by moving a valve. No tired workman is asked to watch the temperature at 5:30 P. M., when he is thinking of going home. The regulator is never tired. It never allows the temperature to vary a single degree. The cans in which the vegetables are contained are sterilized. In other words, all the germs killed by heat. The vegetables in the cans are heated for an hour at 245 degrees. Tell-tale thermometers are fitted to some of the cans while they



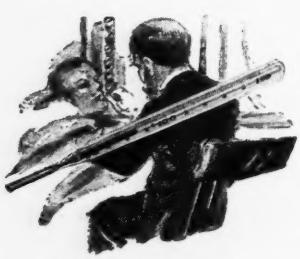
On the heat measuring devices in the canning factory you will find the name "Tycos"

are in the "process kettle," as it is known. Without the thermometers the canner would not know whether the temperature is high enough to kill all germs. Some of the cans of vegetables would spoil on the shelves of the retailer.

On these heat-measuring devices, both the automatic instrument as well as the tell-tale thermometers, is the name Tycos.

No machine is so extraordinarily sensitive, so delicately poised as a man. More than any other mechanism he would not "go," if the operating conditions are not just right. He is peculiarly dependent on heat—both the heat of the sun and the heat he generates himself like every living organism. His temperature must not vary more than two degrees from the normal. And "normal" means 98.6 degrees F. Even a variation of one degree may not be ignored.

Do you wonder now why a physician's first step in finding out what ails a sick man is to take his temperature? He thrusts a little thermometer beneath the tongue, waits for a few minutes, and then reads the temperature. Without the thermometer he would be no wiser than an Indian medicine man. He could not prescribe intelligently. Remember that a variation in temperature from the normal of only one degree may not be dismissed lightly; two degrees is a forecast of illness that may be serious, even fatal. There are one hundred and eighty degree marks on the Fahrenheit scale between the freezing and boiling points. That physician's thermometer must not be wrong by even half a degree. Are you wrong only once out of every three hundred and sixty times?



Without the thermometer a physician would be no wiser than an Indian medicine man

Life and death depend on the correctness of the little instrument that the physician places under a patient's tongue. If it is wrong the physician is misled.

On the highly accurate thermometers used by most physicians is engraved the name Tycos.

Intuition, which means good guessing, used to play an important part in the making of factory candy. The man who could divine the exact moment when the syrup had reached the correct temperature was an expert confectioner. He was highly paid because of his almost psychic powers. Nowadays a man with a thermometer takes his place and does his work far more scientifically. There is no longer any mystery about candy making. Such bewildering terms as "smooth," "thread," "soft ball," "hard ball," "small crack," and "hard crack" are now translated into intelligible Fahrenheit degrees. Any competent housewife can make candy as well as a confectioner, if, like the modern candy maker, she uses a thermometer. A candy manufacturing company simply *must* use thermometers—accurate thermometers. The overheating of the syrup by only a degree means the loss of valuable sugar and of valuable time. Without temperature control there would be no cheap, wholesome candies.

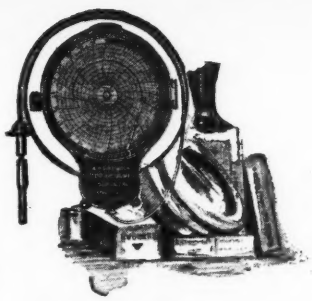
A candy manufacturing company simply *must* use thermometers—accurate thermometers

On the special thermometers used by candy makers stands the name Tycos.

You have heard of vulcanizing as a very important step in the manufacture of rubber goods. Everything that is made of rubber is vulcanized—everything from an automobile tire to an elastic band. When rubber is vulcanized it is mixed with sulphur. The effect is magical. The rubber becomes wonderfully elastic or wonderfully hard. The result desired depends on the amount of sulphur and on temperature control. Without heat the sulphur could not be digested by the rubber. But the heat must be regulated. Every vulcanizing apparatus must have its thermometer and temperature regulator. Without the thermometer there would be no rubber industry—no insulated submarine cables, no automobile tires, no vulcanite utensils, no electric insulators made of rubber.

In the great rubber factories, where heat-

control is so all-important, Recording Thermometers are used that bear the name Tycos.



Every vulcanizing apparatus must have its thermometer and temperature regulator

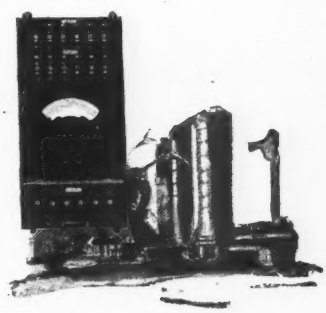
A modern automobile is made not of steel, but *steels*. There are almost as many kinds of steels as there are kinds of wood. Add a little chromium, or nickel, or tungsten, or vanadium—a mere pinch of any one of a dozen different elements—and you produce an alloy-steel with perhaps valuable properties. But without "heat treatment," as it is called, there would be no modern science of metallurgy, no inexpensive automobile. It is heat treatment that makes it possible to produce an alloy-steel axle from which an eighty-ton locomotive can be suspended; to pull a valve-stem out like rubber in a testing machine; to obtain a gear with a surface so glassy-hard that a microscope must be used to detect the wear to which it has been subjected after running ten thousand miles; to manufacture a brake-rod or a steering-knuckle that can be operated a hundred thousand times without weakening.

But heat treatment implies careful heat measurement. The furnaces in which the parts of an automobile are heated must be watched. And watched they are—by a man who never sees them. He sits in front of a series of electrical heat recorders, called Recording Pyrometers, perhaps hundreds of feet from the furnaces. Each recorder is connected with its furnace. If the temperature of a furnace rises or falls ever so little the man at the temperature-control board knows it. He warns the man in charge of the furnace by flashing an electric light. On the pyrometers depends the ultimate quality of the parts that compose an automobile. Every great automobile factory has its heat treatment room.

On the pyrometers that control the furnaces you will find the name Tycos.

In every steel plant, in every glass factory, in every copper smelter, in every plant where furnaces so hot are installed that metal or clay becomes as liquid as water when subjected to their terrific heat, you will see a man now and then setting up a little instrument on a tripod and looking through a telescope. He is finding out how hot is the furnace. He cannot use any ordinary heat-measurer; it would melt away like butter on a stove.

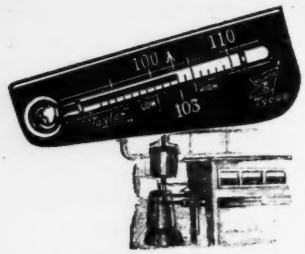
His instrument is the Féry radiation pyrometer. When you understand the principle of its operation you think of the time when you burnt your name on a piece of wood with a lens. The instrument focusses the heat from a furnace or from a white-hot body. Instead of a lens it has a concave mirror, which operates in the same way. When the heat rays strike the mirror they are concentrated on what is known as a thermo-couple. Now the thermo-couple consists merely of two different metals joined together. When they are heated an electric current is generated; the hotter the junction, the more powerful will be the current. It is easy to see that the current has only to be measured in order to determine the heat concentrated by the mirror on the thermo-coupler. That heat may be as high as 3600 degrees F.—hotter than white-hot molten steel. Until the Féry radiation pyrometer was invented high industrial temperatures could be only approximately measured. It has made ceramic processes, for instance, more exact.



Without accurate pyrometers the steel plant would be no better than the blacksmith-shop

On the Féry pyrometers sold in this country appears the name Tycos.

There are poultry breeders who raise fifteen thousand ducklings and twenty-thousand chickens at a time for market. To obtain ducks and hens enough to hatch fifteen thousand eggs would be an impossibility. And if it were possible the



Incubators would be useless without thermometers—without temperature control

percentage of eggs hatched would be unprofitably small. Incubators are surer than warm bird bodies. But incubators would be useless without thermometers—without temperature control. Heat creates life in an egg; but only the right amount of heat. Too much or too little kills. There must be no guessing. And so the great poultry breeders hatch out eggs in huge incubators provided with automatic heat-controlling devices. No one is much concerned whether the temperature is right or wrong; the heat-controlling devices never fail.

On the automatic thermometers used by great poultry breeders is the name Tycos.

Every industry is dependent directly or indirectly on heat-control. A magazine of smokeless powder or dynamite is absolutely unsafe without thermometers that detect the slightest rise in internal temperature. A cold-storage plant would be a commercial failure without temperature control; the recondensing of the ammonia could not be successfully regulated without heat-measuring devices. And that means? Simply that there would be no cheap, cold-storage food; the cost of living would be even higher than it is. A wholesale baker of bread would be well-nigh helpless without thermometers to control his ovens, and to aid him in economizing in flour and fuel. Wherever there is an asphalt-melting tank, a tar and oil still, an ink factory, a paint-making plant, wherever, in a word, there is an industrial process, there you will find a heat-recorder of some kind.

And that instrument will usually bear the name Tycos.

That word Tycos has come to mean dependability. It is applied to the temperature, pressure, indicating and recording instruments made by the Taylor Instrument Companies of Rochester, N. Y. Thermometers were first made in this country by David Kendall. With George Taylor he established the firm of Kendall & Taylor in 1851. That was the beginning of the thermometer-making in the United States, the beginning of the Taylor Instrument Companies, the oldest American firm of its kind and the largest in the world.

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We publish a little book by P. R. Jameson, F. R. Met. Soc., on "The Thermometer and Its Family Tree." It tells very simply how the thermometer was invented by Galileo, how it was developed, and how it is made. The book is yours for 10c postage stamps

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